Technische Universität Dresden
Faculty of Environmental Sciences
Institute of International Forestry and Forest Products
Professorship of Tropical Forestry

Organization of Smallholder Tree Growers, Support Organizations, Linkages and Implications for Woodlots Performance

The Case of Mufindi District, Tanzania

Master Thesis
In partial fulfillment of the requirements to achieve the academic degree of

Master of Science (M.Sc.)

Tropical Forestry and Management

has been submitted.

By
Ombeni Simon Hingi
born on April 4th, 1981 in Njombe, Tanzania

Place and date of submission: **Tharandt, 17.10.2018**

Supervisor: Dr. rer.nat. Auch, E.
Institute of International Forestry and Forest Products
Technische Universität Dresden
Tharandt – Germany

Co-Supervisors:
1. Prof. Dr. Ngaga, Y (DVC – ADMN & F)
College of Forestry, Wildlife and Tourism
Sokoine University of Agriculture

2. Dr. Mbije, N.
Head of Wildlife Management Department
College of Forestry, Wildlife and Tourism
Sokoine University of Agriculture
Morogoro – Tanzania

Permitted/not permitted for lending

Dresden…… ……

Head of the Examination Board

Statement of Authorship

I, Ombeni Simon Hingi, hereby declare that I am the sole author of the master thesis named;

"**Organization of Smallholder Tree Growers, Support Organizations, Linkages and Implications for Woodlots Performance"**

The Case of Mufindi District, Tanzania

which has been submitted to the Faculty of Environmental Sciences, Institute of International Forestry and Forest Products of The Dresden University of Technology today.

I have fully referenced the ideas and work of others, whether published or unpublished. Literal or analogous citations are clearly marked as such.

Tharandt, 17.10.2018 ……..

Place and date Signatutre

SLUB using permission

I, Ombeni Simon Hingi, hereby entitle the Library “Sächsische Landesbibliothek – Staats – und Universitätsbibliothek Dresden and Zwibibliothek Forstwesen”, to make available in their premises my Master thesis for all kind of library usage including reference library.

Tharandt, 17.10.2018 ……..

Place and date Signatutre

Acknowledgments

This study would not have been possible without a considerable support from several individuals, organizations and institutions. All were wealth acknowledging for their contribution however, it was not possible to mention all, but a few deserved to be listed here.

Foremost, profound gratitude is expressed to my supervisors Firstly, Dr. Auch, E. (A major supervisor from Institute of International Forestry and Forest Products of Technical University of Dresden (TUD), Tharandt - Germany), whose constructive ideas, critics, guidance and comments made this thesis successfully done. And secondly, Prof. Ngaga, Y. and Dr. Mbije, N. (Co-supervisors) from College of Forestry, Wildlife and Tourism of Sokoine University of Agriculture (SUA), Morogoro - Tanzania, where field data collection was held, for their acceptance to co-supervise me despite their tight schedules of academic facilitation and administrative duties as Depute Vice Chancellor and Head Wildlife Management Department respectively. I would equally thank Mr. Michael Jenke (Ph.D. - Student at Institute of International Forestry and Forest Products of TU Dresden, in Tharandt) for his heartfelt support for social network data collection and analysis. My major supervisor introduced me to Mr. Jenke, while he was still in Thailand for field work, yet he accepted to support even without having previously known me (this is a special and loving spirit).

I sincerely thank Ms. F. Mbuduka (Marketing and information officer - TGAs) – Private Forestry Program – Iringa and Mr. M. Gwalema (Business and market facilitator – tree growers services) – Forest Development Trust – Iringa for providing useful information about their support and relationship with smallholder tree growers and TGAs necessary for mapping tree grower's social networks in the study area.

My gratitude is extended to Dr. T. Msuya (Executive secretary – Tanzania Forest Fund – TaFF) and Ms. Teddy (Monitoring and evaluation officer – TaFF) for devoting their time to provide me with valuable information about TaFF activities and specific information and data about the fund's support to UWAMINU TGA in Nundwe village. In addition, I would thank the District Executive Director of Mufindi district Prof. R. S. Shemdoe for granting me permission to interview households and institutions in the district, Mr. N. Kitaluka (For DFO – Mufindi DC and Mr. Mshana (Sao Hill forest manager, division 3 – Ihalimba) both for providing data about how they participate in smallholder support and extension services in the study areas.

I am equally indebted to Mr. H. Msigwa (Chairperson – UWAMINU TGA), Mr. P. Ngoda (Chairperson – ICFG TGA) for being good focal persons for TGA members and providing useful information about their TGAs. In the weight, I thank all village leaders including Village executive officers and Villages chairpersons for Igowole, Mninga and Nundwe villages for their kind cooperation for selection of focal respondents, providing highlights about tree growers and keeping our harmonies stay in the villages throughout the entire period of data collection task.

Special thanks goes to DAAD through the Government and people of Germany for granting me a scholarship to study this program and paying flight costs to carry out my study in Tanzania; The Institute of International Forestry and Forest Products for admitting and recruiting me intensively for the two years; The WoodCluster Project and Project staffs (Prof. J. Pretzsch – project leader (TUD), Dr. M. Domke – project coordinator (TUD) and Dr. F. Mombo project coordinator – (SUA)) for Coordinating the study mission in Cooperation with SUA in Tanzania; and My Employer (Malinyi District Council) and the Government of Tanzania for granting me a paid study leave to undertake this master program.

I would, thank all contributors, field respondents and fellow students in the MSc Tropical Forestry and Management program for their cooperation.

Lastly and most importantly, I thank my Almighty God who guided and kept my safety to successful completion of the two years MSc. program. Amen!

Dedication

This study is dedicated to my beloved parents (my late father Mr. Simon Hingi) and my Mother Ms. Alatwiuka Mwenda, who laid down the foundation of my education that brought me this far.

I equally, dedicate it to my beloved wife Jane, for accepting me to undertake this two-year study, despite her being a student too. She committedly took over my role as the father, as well as remaining as a mother of the family. This was a loving spirit, I recognized, value and appreciate.

THE TABLE OF CONTENTS

LIST FIGURES

LIST OF TABLES

LIST OF ABBREVIATIONS

CIAT = International Center for Tropical Agriculture

COINFO = Inter-Community Forestry Committee

ETFRN = Europian Tropical Forestry Research Network

FAO = Food and Agricultural Organization of the United Nations

FDT = Forest Development Trust

FFPOs = Forest and Farm Producer Organizations

NAFORMA = National Forest Resources Monitoring and Assessment of Tanzania Mainland

NGOs = Non-governmental Organizations

OECD = Organization for Economic Co-operation and Development

PFP = Private Forestry Program

RA = Rapid Appraisal

RSA = Republic of South Africa

RSB = Roundtable on Sustainable Biomaterials

SNA = Social Network Analysis

SUA = Sokoine University of Agriculture

TaFF = Tanzania Forest Fund

TGA = Tree Grower Association

TFS = Tanzania Forest Services

TUD = Technical University of Dresden

URT = United Republic of Tanzania

USAID = United State of America International Development agency

Abstract

Woodlots have become the most important investment opportunity among smallholders of Mufindi district in the southern highlands of Tanzania. Smallholder woodlots are also a major source of wood supply contributing to narrow the supply gap which in 2015 was reported to be 19.5 million m^3 per year, where the main wood consumption sectors being construction and domestic heating energy. However, inadequate information about smallholder woodlots, supporting organizations, their linkages and impacts on woodlots performance derail its sustainable development and potential contribution for wood supply, poverty alleviation and environmental sustainability. The present study therefore, specifically explored the tree grower's motivations, knowledge base and challenges to woodlots farming; assessed woodlot tree species, products, and performance; assessed the linkages by analyzing social networks of tree growers with support organizations and evaluated their impacts on the performance of their woodlots. Both survey and case study approaches were used to collect data in the three villages namely: Igowole, Mninga, and Nundwe, in Mufindi district, Tanzania. Mufindi district was purposively selected because of advanced smallholder tree growing. In all the three villages, a total of 93 actors were approached, including 72 tree grower households, 24 from each village, 14 nursery operators and 9 support organizations by snowball sampling. Then, an in-depth interview was conducted to all 72 sampled households. Similarly, 72 woodlots were assessed by rapid appraisal (RA) approach and their performance compared. While 48 woodlots in Igowole and Nundwe villages from organized farmers in tree grower associations (TGAs) and unorganized tree growers were assessed, and performances compared. At Mninga village, all the 24 assessed woodlots were from unorganized tree growers and acted as a control group. Quantitative data were analyzed using SPSS version 20 and the results summarized in tables and graphs by excel spreadsheets. Woodlots performance and social network data were analyzed using R – software. Based on the study respondents, the results revealed that tree growers were motivated to plant and manage trees mainly for economic reasons (48%, 45%, and 51%) and land security reasons (37%, 30% and 31%) for Igowole, Mninga and Nundwe respectively. About the knowledge base, most tree growers (75% – 100%) in all the three villages had the knowledge on land preparation, nursery management, planting, weeding, pruning, and fire protection. But in all the villages, respondents did not have knowledge on forest growth principles and dynamics, on objectives for the product of the plantations and influence of tree spacing on such desired products. Again, other analyses revealed that; fire, inadequate knowledge, inadequate capital, lack of improved seeds and low timber/tree prices were the main challenges constraining farmers to plant and manage trees in woodlots in the three study villages. And, the main tree species in the study area were *Pinus patula* and Eucalyptus sp. Organized tree growers were much more supported by organizations than the non-organized ones. Logistic regression analysis performed in R ($P = 0.05$) revealed significant difference in woodlots performance among organized farmers based on gaps ($P = 0.00216$), growth condition ($P = 0.04478$) and planting space ($P = 0.02013$) criteria. That means, woodlots from organized farmers were generally performing better than those from unorganized farmers. The better performing woodlots of organized tree growers were contributed by social capital through networks and the role of collective action of the farmers in TGAs. Nursery operator farmers were the main source of tree seedlings for unorganized tree growers, while organized tree growers obtained most of the resources including knowledge, seeds and planting materials as well as funds from tree grower associations (TGAs), which were supported by organizations. Thus, for future planning, nursery operator farmers should be supported for improved seeds and planting materials to benefit the nonorganized tree growers. Nursery operator farmers should be encouraged to join TGAs, and TGAs should generally be adopted as an effective smallholder tree grower's support platform in the study area.

Keywords:

Woodlot, support organizations, rapid appraisal, social capital, Pinus patula, Eucalyptus sp, TGAs.

CHAPTER ONE

1. Introduction

Tanzania forests cover about 38% of the total land area, equivalent to 33,555,000 ha (URT, 1998: Bunting et al., 2013). About 13 million hectares of this total forest area has been gazetted as forest reserves (over 80,000 hectares of the gazetted area is under plantation forestry), 1.6 million hectares are under water catchment management, about 2 million hectares forest/woodlands are within national parks and game reserves (wildlife protected areas), and about 19 million hectares are non-gazetted forest land (URT, 1998). However, forest cover is drastically declining from time to time. For instance, between 1990 and 2010, a total of 8,067,000 ha; an average of 403,350 ha which is equivalent to 1% of total forest cover was being lost per year (Bunting et al., 2013). This loss was largely attributed to increased extraction of wood from forests to meet human energy and construction demands. Also, needs for agricultural land mainly for food production to feed and settle the rapidly growing population were reported (Agwanda & Amani, 2014). For example, the total population of the United Republic of Tanzania according to the 2012 census was 44,929,002 people, compared to 34,443,603 in 2002. That means, the population of Tanzania increased almost by 30 % (equivalent to 10,485,399 people) in the past decade, at the growth rate of 2.7% per annum (Agwanda & Amani, 2014). This population increase had significant negative implications (Agwanda & Amani, 2014) including increased pressure on the exploitation of the forest resources especially the forests on the non-gazetted forest land areas because of weak management (URT, 2013).

Besides, the demand for wood material for both industrial, commercial, construction as well as for heating energy has increased tremendously in recent years. This increase resulted in a significant shortage of wood supply in Tanzania (Indufor, 2011). According to NAFORMA (2015), the current estimated annual consumption of wood in Tanzania is 62.3 million m^3 while the annual allowable cut is only 42.8 million m^3 per year. This supply, is thus unable to meet the demands sustainably causing shortage gap of around 19.5 million m^3 per year from legal sources This deficit is currently covered by overharvesting of accessible forest areas and illegal harvesting especially from natural forests including in protected areas leading to growing degradation of the remaining forests and woodlands (NAFORMA, 2015).

Reflecting on the situation, the state responded to it in different ways. For example, the Tanzania forest policy was reviewed in 1998 as a step to revert the prevailing situation (Ngaga, 2011), the Tanzania forestry program was embarked in 2000 to promote and enhance tree planting countrywide (URT, 2012), and Tanzania forest fund (TFF) was established in 2010 to provide long-term, reliable and sustainable financial support for enhancing conservation and management of forest resources by individual farmers, groups, community and institutions all over the country (URT, 2012). One of the outcomes of these government efforts was increased participation of the private sector, civil society organizations, and communities in

plantation forestry. Moreover, there has been the increased interest of both public agencies and nongovernmental organizations as well as development partners in promoting plantation forestry especially by supporting smallholders in woodlots establishment.

However, although the promotion of smallholder woodlots is an important strategy to increase wood production, yet the involvement of smallholders in the wood sector has mainly been facilitated by many other agendas. For example, first; government policies for rural development target these rural areas where these farmers live. And secondly; the new global development agenda and Sustainable Development Goals (SDGs) that argues that forest producer organizations are effective operating systems to deliver the SDGs (FAO & AgriCord, 2016). Despite contributing to wood supply, well-performing smallholder woodlots can contribute to the livelihood's improvement, poverty reduction and economic growth to the rural people.

1.2 Problem Statement and Justification

Over the years, government forest plantations were the main source of wood supply (Indufor, 2011; Ngaga 2011), however, in recent years wood supply from the government plantations decreased, while demand in the market has increased. As a result, the current supply is by far unable to meet the demands (NAFORMA, 2015). As such both government legal reforms, stakeholders and organizations supported the smallholder plantations development to increase wood production and diminish the supply shortage gap. Currently, smallholder woodlots are already on pace and becoming the major source of wood supply for construction and energy in Mufindi district as well as in the country (FAO & AgriCord, 2016).

Despite this progress, information about smallholder tree growers, their organization, supporting organizations, linkages and implication for the performance of their woodlots is inadequate. This derails sustainable development of smallholder woodlots and its potential contribution to wood supply as well as poverty alleviation. For example, information about the current farmer's motivations to establish and manage woodlots, their knowledge base and challenges constraining them is scarce in the current literature. Information concerning farmer's preferred tree species, as well as reasons for such preferences, current woodlots products both tradable and non-tradable from different tree species, is not sufficient. In addition, information about how tree growers are organized and their linkage to supporting organizations again are however lacking. Previous studies about plantation forestry focused more on large enterprises, dwelling on forest management for the production of quality industrial wood and comparative profitability between private and public forest plantation enterprises. The handful studies which were done on smallholder woodlots in the study area focused on the contribution of woodlots to the district economy, gender-based livelihoods contribution as well as timber trading (Tweve, 2016; Nkwera, 2010; Singuda, 2010).

Thus, the present study examined farmer's motivations, knowledge base and challenges in woodlots establishment and management. The study mapped tree species preferences and smallholder woodlot trees products including both tradable and non-tradable. It also analyzed social networks of different actors linked to woodlots farming including woodlot farmers, tree grower's associations (TGAs) and support organizations. Finally, the study describes relationships between different actors involved in woodlots farming and examined the influence of woodlot farmer's organizations to woodlots performance. The understanding woodlot farmers' motivations, knowledge base, and challenges were important to unveil the current drivers of increased woodlot establishment and identify and address farmers' knowledge gaps and challenges for sustainable woodlots management in the area. On the other hand, assessing the woodlot performance was vital, because woodlots performance determines the product quality necessary for improved markets. Furthermore, examining the current woodlot products both tradable and non-tradable was important for designing product upgrading option including appropriate technologies and relevant knowledge necessary to improve productivity and woodlots logs processing efficiency. Such improvements would increase farmers' financial returns in the future. On the virtual of support organizations, it was important to determine the influence of such organizations to woodlots performance. In additional, documenting support organizations was necessary for evaluating their impacts, documenting lessons learned for management of strengths as well as identifying entry points for future supports in the study area and elsewhere in the country.

Thus, the present study filled the knowledge gap by availing the documented information in the findings, thus contributing to as a roadmap to government and private planners, policy and decision makers on the organization of smallholder tree growers as well as pinpointing means to support them. Because, well organized and supported smallholder tree growers can contribute to increased wood production, consequently increased wood supply that can bridge the current gap. In addition, improved smallholder woodlots farming has a potential to improve farmers' incomes, regulate climate, improve soil for improved crop productivity and ensure farmer's resilience to impacts of climate change. In general, effective and efficient smallholder woodlots establishment and management have a potential to transform incomes of the rural people and ensure environmental sustainability.

1.3 Objectives

1.3.1 General objective

The general objective of this study was to examine the organization of tree growers, support organizations, their linkages, and impacts on woodlots performance.

1.3.2 Specific objectives and research questions

1: To explore the smallholder's motivations, knowledge base and challenges to woodlots farming.

i. What motivates farmers to plant trees?

ii. Which knowledge/skills do woodlot farmers have about tree growing and management and where do they get it from?

iii. Which challenges constrain woodlot farmers in growing trees and how can they be addressed?

2: To examine woodlot tree species preferences, products, and performance.

iv. Which tree species do farmers prefer to plant? Why? And from where do they get the seeds/seedlings?

v. Which products do woodlot farmers produce, use and/or sell from different tree species?

vi. How are the woodlot farmers organized? and how are woodlots in organized and unorganized farmers performing?

3: To analyze woodlots farmer's organizations, support organizations and their linkages.

vii. Which organizations have supported woodlot farmers? and how are they linked?

viii. What are the objectives, mandate, and expectations of support organization from woodlots farmers?

ix. When last did the farmers receive the support from support organizations

4: To identify and evaluate the structures from the current farmer's organization necessary for future organizational development and woodlots performance improvement.

x. What are the structures from the current farmer's organization and what can be recommended for more effectiveness and efficiency, as well as for woodlots performance improvement in the study area?

1.4 Structure of the thesis

This thesis is organized into six chapters. The first chapter; provides a background of the research topic, the research problem, and justification. The second chapter provides definitions of important terms, concepts and explains fundamental theories in which the study was built on. In the third chapter; research design, study area, sources for data, methods of data collection and analysis are presented. The fourth chapter presents the study results. The fifth chapter presents a discussion of results. And in the sixth chapter; conclusions, recommendation, as well as a future research direction, are presented.

CHAPTER TWO

2. State of the Art and Theoretical Framework

2.1 Definitions of study related terminologies and concepts

Smallholder farmers are defined in various ways depending on the context, country, and special ecological zone. Often the term 'smallholder' is interchangeably used with 'small-scale', 'resource-poor' or 'peasant farmer' (RSA, 2012). However, in most cases, individuals' land size is regularly used as an indicator (RSB, 2013). Globally, land less than 500 ha are categorized as farms, and holdings above 500 ha fall under estates (RSB, 2013). RSB (2013) further categorizes farms as follows: small farm: <10 ha; medium farm: 10 ha – 75 ha; Large farm: 75 ha – 500 ha. Definitions which include other indicators, such as labor input, farm management, and income are also widely used. Baker et al. (2017) for example defines **s**mallholders as farmers that operate family-run farms using largely their own household labor and that are weakly connected to markets. However, for the purpose of this thesis, smallholders are defined as those farmers with a landholding of <75 ha, on which they grow subsistence crops and plant trees. In addition, smallholders in the study area rely largely on family labor or a combination of both family and hired labor. The term smallholder farmer, in this study, however, was used interchangeably with tree grower and woodlot farmer.

A woodlot is defined as a piece of land dedicated to tree planting usually located around a household or within a village (Singunda, 2010). Similarly, in this thesis woodlot is defined as a piece of land dedicated for planting and managing trees which can be located around a household residence, within a village or neighboring village for production of wood material and other amenity values. A woodlot may be owned by an individual, a household or by a community. A woodlot also includes land that institutions such as schools or churches dedicate for tree planting and management. Therefore, in a broad sense, a woodlot includes the area dedicated to planting and management of trees by a household, village/community or institutions such as schools and groups. Moreover, an organization is an entity comprising multiple people with a collective goal, such as associations, cooperatives, and institutions (Schlauch et al., 2012). In the present, this study an organization includes nongovernmental organizations, associations, private individuals as well as government departments and agencies.

2.2 Smallholders and smallholder's forest organizations in the world

In developing countries, approximately 3 billion rural people live in about 475 million small farm households, and about two thirds (2/3) work on land plots smaller than 2 hectares (FAO, 2015). They mainly depend on family labor for farming. Even though the majority of them are poor, food insecure, limited in market access and services but, they farm their land and produce food for a substantial proportion of the world's population (FAO, 2015). Farm activities are complemented by multiple economic activities, often

informal but contributing to their small incomes and livelihoods. The differences in smallholder farms between countries can be significant, and often reflect differences in the stages of development across countries (RSB, 2013) because the evolution of the small farm is intrinsically related to the process of economic development (FAO, 2015; RSB, 2013).

The total estimated area of forest plantation worldwide is 187 million hectares. Nonetheless, 26% of this area is on smallholder farmers and community woodlots (FAO, 2015), also known as non-industrial plantations (Carle et. al., 2002). In addition, industrial plantation accounts for 46% and the other 26 % is listed as unspecified of the global forest plantation estate (FAO, 2015). In the past decades, smallholder tree plantations were often initiated for subsistence needs and/or improving the ecological conditions of the landscape such as water catchments (Snelder & Lasco, 2008). However, because of the decline of timber from natural forests, increased awareness on conservation, increased forests kept under protected area management and growing demands for wood products, smallholder plantations have therefore become increasingly important for timber supply. For example, it is estimated that 3.1 million ha of forests are smallholder plantations supplying wood to panel, furniture and other industries in the Philippines (Midgley et al., 2017). While in Vietnam, more than 600,000 ha of acacia smallholdings produce more than 9 million m^3 of wood worth as export woodchips (Maryudi et al., 2017). Growth in timber market, linked to processing industries and energy demands for heating in developing countries has raised demands for wood material, and become a motivation rural farmers to engage in woodlot management with the objective of increasing their income (Snelder & Lasco, 2008). The role of smallholder communities in plantation forestry has regained importance in government policies and programs in Africa and elsewhere in the world.

Worldwide smallholder's participation in tree growing is increasing. Similarly, smallholders are increasingly organizing into forest producer organizations. Forest producer organizations include indigenous people and local community organizations, tree grower/agroforestry/or forest owner associations, producer cooperatives, umbrella groups and federations that produce, process and market goods originating from forest products (Pasiecznik & Savenije, 2015). Some examples include: (1) 250 forest producer organizations aggregated into 11 provincial associations in Guatemala. These associations represent 388,000 forest producers who are sustainably managing 750,000 hectares (ha) of forest land equivalent to 17.5% of the national forest cover (ETFRN, 2015). (2) The communities of Chittagong Hill Tracts of Bangladesh indigenous people have organized into 10 groups of 25 to 30 members adopting new livelihood options to manage community conserved forest areas supported by a project support (FAO & AgriCord, 2016). (3) The Inter-Community Forestry Committee (COINFO) was one of the first organizations for forest management to be established in Bolivia established by the support of Germany Development Cooperation agency (*Deutscher Entwicklungsdienst*) and the International Center for Tropical Agriculture (CIAT) in 2005. Until 2005, COINFO as an umbrella organization representing 17-

member communities in Velasco province managing 90,000 hectares (ha) of rich forests (ETFRN, 2015). COINFO is well recognized by the government forest authority, municipalities, district governments and the forestry sector of Bolivia.

2.3 Historical development of plantation forest and smallholder woodlots in Tanzania

Activities of tree planting in Tanzania dates to the German colonial era between 1899 to 1914 when administrators and settlers planted trees in and around offices and residences (Ngaga, 2011). The tendency continued under British rule from 1918 to independence in 1961. Later, the practice was gradually adopted by the local people who worked for the colonial administrators. After independence, the role of forest sector administration was vested to the central government control and continued to encourage people to plant trees in their homesteads (URT, 2013). Later, with the establishment of local governments, especially district councils in 1982, nurseries were established which produced seedlings for planting in public buildings such schools as well as the local residences (Ngaga, 2011). Ngaga (2011) argues that different tree species were planted for different purposes for example; for timber production, building poles, firewood and charcoal production included exotic species such as pines, cypress and Grevillea for timber whereas eucalyptus, black wattle (*Acacia mearnsii*) and *Cussonia spp*. for poles and charcoal: for fruit, shade provision and water sources protection and conservation included *Cussonia spp., Ficus spp., Syzygium spp*. and *Albizia spp*. In addition, bark from black wattles (*Acacia mearnsii*) was mainly used for tannin production. Farmers have continued planting and managing trees in their woodlots. It should be noted that tree planting and management in woodlots has increased in recent years. Although the practice of tree planting was adopted from the colonial time, the objectives have changed from general purpose planting to commercial planting mainly for income improvement.

2.4 Smallholder forest organizations in Tanzania

The well-known and old smallholder forest organization system in Tanzania is the participatory forestry management programs (PFM) in the management of natural forests. These include the Joint Forest Management (JFM), an approach used to manage national forests with neighboring communities and (PFM) in the management of set aside village forests.

In recent years, due to an increase in smallholder participation in plantation forestry through woodlots establishment, a new form of organization was promoted i.e. the tree grower's associations (TGAs) (PFP, 2016). Tree grower associations (TGAs) have been promoted by support organizations such as Private Forestry Program (PFP) as a farmer support platform for smallholder tree growers in the Southern Highlands. At the moment, there are many TGAs in the Southern Highlands region, but (PFP), was supporting 133 TGAs with 8,089 members of which, 29 TGAs are in Mufindi district (PFP, 2016).

However, the objective for their formation have been: to promote smallholder participation in woodlots and extend woodlots areas, overcome the marginalization, increase their bargaining power and market contacts, secure land tenure, access market and credits in order to boost social and economic benefits among smallholders (FAO et al., 2014: FDT, 2015). Moreover, according to ETFRN (2015), organizations of tree grower associations in TGAs, have several advantages: firstly, to speak with a more powerful voice, lobby buyers and decision makers. Secondly, to reduce transaction costs and provide services to their members. And thirdly, to adapt strategically to new opportunities. Other requisites include strong collective and evolving interests, autonomy from the government or other agencies and institutions, democratic decision making, clarity of internal roles and responsibilities, transparent financial reporting, successful experiences across members, self-reliance and internal management.

But, the present study, focused on both organized tree growers into TGAs and non-organized tree growers. The woodlots performance between organized and unorganized farmers was assessed, tree grower supporting organizations and their linkages were evaluated as well as their impact on the performance of woodlots was discussed.

2.5 The theory of social capital

Smallholder woodlots farmers are increasingly gaining collective action, as groups in associations (TGAs) in Mufindi district and entire southern highlands of Tanzania. Although, the smallholder's organizations as tree grower associations (TGAs) for farm forestry are still at infancy stage but, assessing the assortment of their social capital and collective action potential to improving woodlots performance was essential. However, it is well established that, the potential of smallholder collective action depends largely on factors such as group organization, member/farmer and product characteristics, as well as the institutional arrangements surrounding their creation (Yin & Pretzsch, 2018; Markelova & Mwangi, 2010). In fact, the concept of social capital is increasingly being used to explain cooperative behavior within and between groups (Valente & Pitts, 2017; Putnam, 1993). Indeed, it is well acknowledged by different proponents as well as international development community that; networks, trust, reciprocity, and social norms are important forms of social capital that facilitate cooperation for mutual benefit (Schlauch et al., 2012; World Bank, 1999; Australian Bureau of Statistics, 2002; Putnam,1993). Nonetheless, a variety of resources are necessary for communities to act collectively (Bodin & Crona, 2009; Darr, 2008; Bodin et al., 2006). For tree growers, such resources mainly include training (knowledge), quality seeds/seedlings and planting materials, information, funding, and credits necessary to establish and manage tree in woodlots. Also, social bonds and norms are important for both communities and individuals to form human capital (OECD, 2007). Different scholars have argued that social capital can: facilitate social mobility as well as provide access to resources (Jenke, 2013; World Bank, 1999; Putnam,1993). In addition, social capital can be a means to

harness social support (Jenke, 2013), lower transaction costs, facilitate cooperation and collaboration (Yin & Pretzsch, 2018), access to innovations, knowledge, and market (Ostrom & Ahn, 2008).

There is no universal agreed-upon-definition of social capital (Schlauch et al. 2012; Claridge, 2004). However, numerous definitions of social capital are found in the literature. For example; term social capital was first defined by a French sociologist Pierre Bourdieu (1930–2002), who was interested in the ways in which society is reproduced, and how the dominant classes retain their position. Bourdieu (1986:248), defined social capital as "the aggregate of the actual or potential resources which are linked to possession of a durable network of institutionalized relationships of mutual acquaintance and recognition or to membership in a group which provides each of its members with the backing of the collectively owned capital. According to him, social capital is equally important as other forms of capital including physical capital, human capital and financial capital. Later, the concept of social capital greatly stimulated by famous scholars such as James Coleman (1988, 1990) and Putnam (1993). They attempted to define social capital rigorously and to identify conceptually sound and practically useful bounds of the concept. Coleman (1990) defined social capital as a variety of different entities which consist of some aspect of social structure, facilitate certain actions of actors whether personal or corporate actors within the structure that implicitly considers relations among groups, rather than individuals. While Putnam (1993) defined social capital as those features of social organizations such as networks of individuals or households, and the associated norms and values, that create externalities for the community. Common to most definitions, is the focus on social relations which have productive benefits to the actors involved.

The definitions for social capital can vary depending on three main perspectives. The first focus is basically on the relations an actor maintains with other actors. Second focus can be on the structure of relations among actors within a collectivity. And the third focus can be on both types of relations called linkages (Adler & Kwon, 2002). Oh, et al. (1999) called a focus on internal relations as 'bonding' that means connecting like-people in similar situations. On the other hand, Woolcock (1998) called a focus on external relations as 'bridging' that means connecting like-people in dissimilar situations or connecting people with formal institutions outside of the community (OECD, 2007). According to Adler & Kwon (2002), the focus on both relations that, actors maintain with other actors, the structure of relations among actors within and outside a collectivity form the linkages hence, the focus of the present study. In the view of tree growers, such networking can enhance communication, knowledge and information flow and technological exchange within farmers themselves (endogenous) as well as outside (exogenous) necessary for woodlots development in the study area.

The present study uses network approach of social capital to assess the linkages or networks (internal and external relations) of the woodlots farmers and evaluate if such linkages have affected the farmer's woodlots

performance in the study area. As such, one way of assessing linkages in social capital studies is by Social Network Analysis (SNA) (Dempwolf et al., 2012). Nevertheless, the present study explores the relevance of important forms of social capital including: networks, trust, reciprocity and social norms as pointed by different academics (Schlauch et al. 2012; Putnam, 1993; Coleman, 1990) to ascertain the validity of the social capital theory in which the study is fundamentally built on. In fact, social norms, values, and beliefs shared by group members reduce transaction costs because, individuals tend to be less reluctant to sacrifice some personal benefits if norms of reciprocity guarantee future benefits (Jenke, 2013; Darr, 2008; Ostrom & Ahn, 2008).

2.6.1 Social network analysis (SNA)

Social network analysis refers to the mapping and measurement of relationships and flows between people, groups, organizations and other connected information/knowledge entities (Hanneman & Riddle, 2005). The nodes in the network are the people, groups, institutions (actors), while the links show relationships or flows between the nodes. SNA provides both a visual and a mathematical analysis of human and organizational relationships. To understand networks and their participants, the locations and groupings of actors in the network are evaluated. According to Hanneman & Riddle (2005), such networks show the distinction between the three main themes popularly called individual centrality measures that include: Degree Centrality, Betweenness Centrality, and Closeness Centrality (described in the later sections). On the other hand, a network refers to a collection of actors or egos in sociological studies, connected by lines, referred to as 'edges' or 'ties' (Hanneman & Riddle 2005). Network analyses hold the potential to reveal characteristics of the social environment and identify structural patterns that might be limitational or favorable to association performance (Dempwolf & Lyles, 2012). Previous studies have identified the importance of different patterns of social interactions and relationships between stakeholders to manage natural resources with focus on natural forests (Jenke, 2013; Bodin & Crona, 2009; Bodin et al., 2006), but few have considered their implications for the performance and operation in smallholder organized farm forestry. In addition, SNA provides the opportunity for multi-level analyses with consistency to the social reality of the rural areas (Valente & Pitts, 2017; Schlauch et al., 2012; Darr, 2008). Despite such strengths, however, methodological criticism of social network research exists. Social network analysis shortfalls mainly concerns the inappropriate research instruments that lead to reliance on recall data, which have been shown to partly lack validity and reliability (Valente & Pitts, 2017); the lack of a standardized name generator, which impairs the comparability of network studies; and the relative underdevelopment of methods suited to grasp network dynamics (Darr, 2008).

2.6.2 Degree Centrality

In SNA, degree refers to the number of direct connections a node has in the network system. Such that the node with the highest number of direct connections in the network is, however, the most active node in the network. Such a node is called a connector or hub in a network. A common wisdom in SNA is that “the more connections, the better." Although, this is not always the case, because it depends on where those connections lead to and how they connect the otherwise unconnected. While the count of a number of ties directed to a node is called indegree centrality, count of the number of ties a node directs to others is called outdegree centrality.

2.7 Reciprocity

Reciprocity means that in response to friendly actions, people are frequently much nicer and much more cooperative than predicted by the self-interest model; conversely, in response to hostile actions they are frequently much nastier and even brutal (Grootaert & Bastelaer, 2001). Reciprocity is fundamentally different from “cooperative” or “retaliatory” behavior in repeated interactions. These behaviors arise because actors expect future material benefits from their actions. But, in the case of reciprocity, the actor is responding to friendly or hostile actions even if no material gains can be expected. On the other hand, reciprocity means, exchange of favors among individuals without expectation of immediate returns from the recipients. As a result, reciprocity encourages the individual to balance their own self-interest with the good of the group or community (Schlauch et al., 2012).

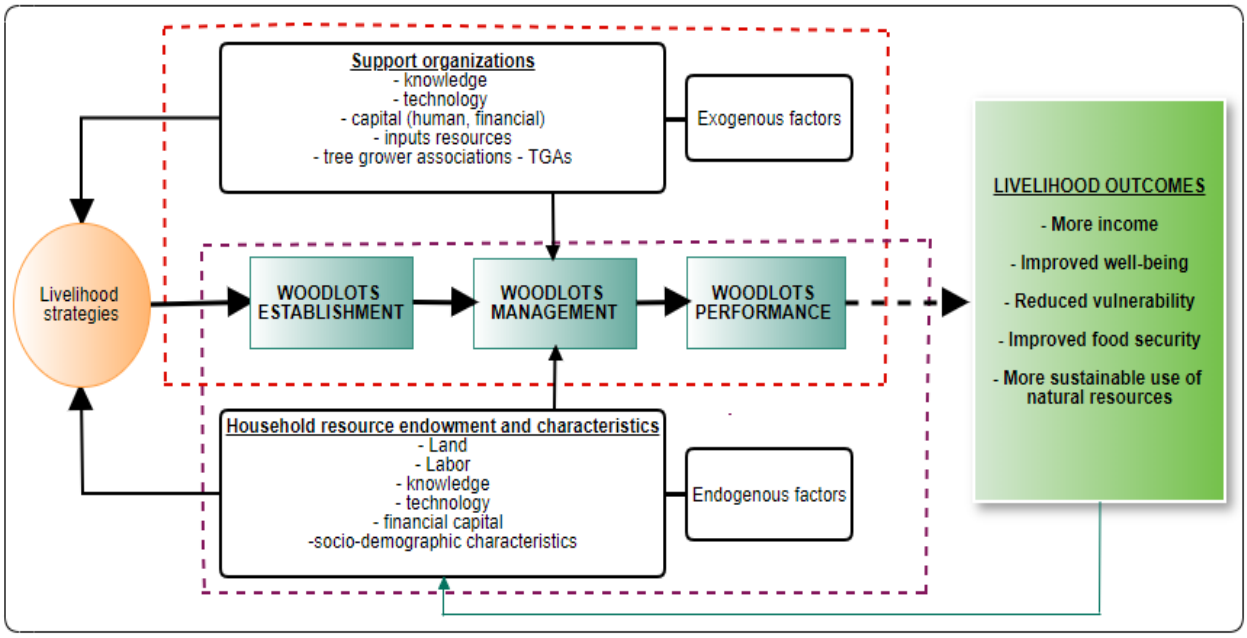
2.8 Trust and social norms

Trust is the expectation that arises within a community of regular, honest, and cooperative behavior, based on commonly shared norms, on the part of other members of that community. Nevertheless, shared social norms together with trust enable those in a community to more easily communicate, cooperate and to make sense of common experiences. On top of that, trust has an important role in reducing the social and business "transaction" costs (Australian Bureau of Statistics, 2002). Relationships depend on trust. Trust depends on a culture of shared values. There is not one unique pathway to trust. A statistical framework for social capital contains elements pertaining to networks and social norms as well as scope for their measurement (Gaur, 2017).

2.9 Conceptual framework

The study follows the ‘Farming System’ approach for the analysis of smallholder farms with a special focus on woodlots. Woodlots in a farm system consist of inputs that include resources that the household allocates for woodlots such as labor, capital, land, and technology. In addition, a household is characterized by socio-demographic characteristics such as household gender, level of education and size. Both household resource

endowment (farm system inputs) and the household characteristics compose the endogenous factors that influence the household decision to establish and manage woodlots. Indeed, the way a household manages woodlots consequently affects the woodlots performance. On the other hand, a household farm system is influenced by other factors from outside. Some of such factors are support organizations, policy framework, and market access. Endogenous and exogenous factors equally affect the household's decision making to establish and manage woodlots (Oduro et al., 2018; Insaidoo, 2012; Nsiaha & Pretzsch, 2010). In fact, the present study examined all endogenous factors, while for exogenous factors only support organizations were included and their impacts on the current woodlot's performance were determined. While the endogenous factors were evaluated in the context of tree grower households and their networks and linkages among other tree growers (bonding social capital). The exogenous factors were evaluated under the context of tree grower households, tree grower associations (collective action/TGAs) and linkages to support organizations (bridging social capital). Conceptualizing this was necessary to ascertain the role of tree grower associations (TGAs) by two ways (1) analyzing and visualizing social networks and linkages of both organized and unorganized tree growers. And (2) assessing the woodlots of both organized and unorganized tree growers and comparing their performances. Those two ways determined the impact of tree grower organizations (TGAs) and linkages to support organization on woodlots performance. In essence, endogenous and exogenous factors affect the household livelihood strategies and one of it is the establishing a woodlot. Similarly, endogenous and exogenous factors affect the way a woodlot is managed, thus determining its performance consequently affecting the tree growing household's livelihood outcomes. That means the better the woodlots performance, the better the tree grower's livelihood outcomes and vice versa. Indeed, household's livelihood outcomes affect her/his decision to re-establish a woodlot, how such woodlot will be managed, consequently affecting its performance thus, creating a cyclic of interdependence factors (Figure 1).



Source: Modified by the author from (Nsiah & Pretzsch, 2010).

Figure 1: A Conceptual framework for factors influencing household woodlots performance

CHAPTER THREE

3. Research Design, Methods, and Materials

3.1 Research Design

This study uses a case study approach, an in-depth case examination within a real-life context (Yin, 2006). According to Yin (2006), case study method has the potential to facilitate the research to answer the questions: i) "why", which in this study the intention was to unveil *why* smallholder farmers are increasingly engaging in woodlot farming? ii) "how", in this case, how are the farmer's woodlots performing? and how are they (farmers) linked to support organizations? and, iii) "what", which sought to understand the challenges and constraints woodlots farmers are facing and the impacts of farmer's organizations and linkages on woodlots performance? Case study approach was, therefore, suitable because it allows for in-depth analysis and interaction with research interlocutors in the in the study area. The case study design also allows research to retain holistic and meaningful characteristics of real-life events such as individual life cycles, organizational and managerial processes, neighborhood change, individual and group relations, and the maturation of industries (Aberdeen, 2013). Besides, one of the aims of this thesis was to identify woodlots actors and their relationships by analyzing their social networks and determine social capital of woodlots farmers to reveal its influence on woodlots development and performance in the study area. Thus, the case study approach was a suitable approach to thoroughly identify actors and map their relations. Moreover, both qualitative and quantitative data were collected through multiple data collection techniques such as household survey, focused group discussion, key informant interviews, rapid appraisal (RA) and direct observation. The application of a wide variety of data collection techniques was important to increase the validity and reliability of the information (Fletcher et al., 1997; Yin, 2006). Nevertheless, a variety of methods were used to analyze data, also to increase the validity and strength of the results.

3.2 Selection of the Study Area

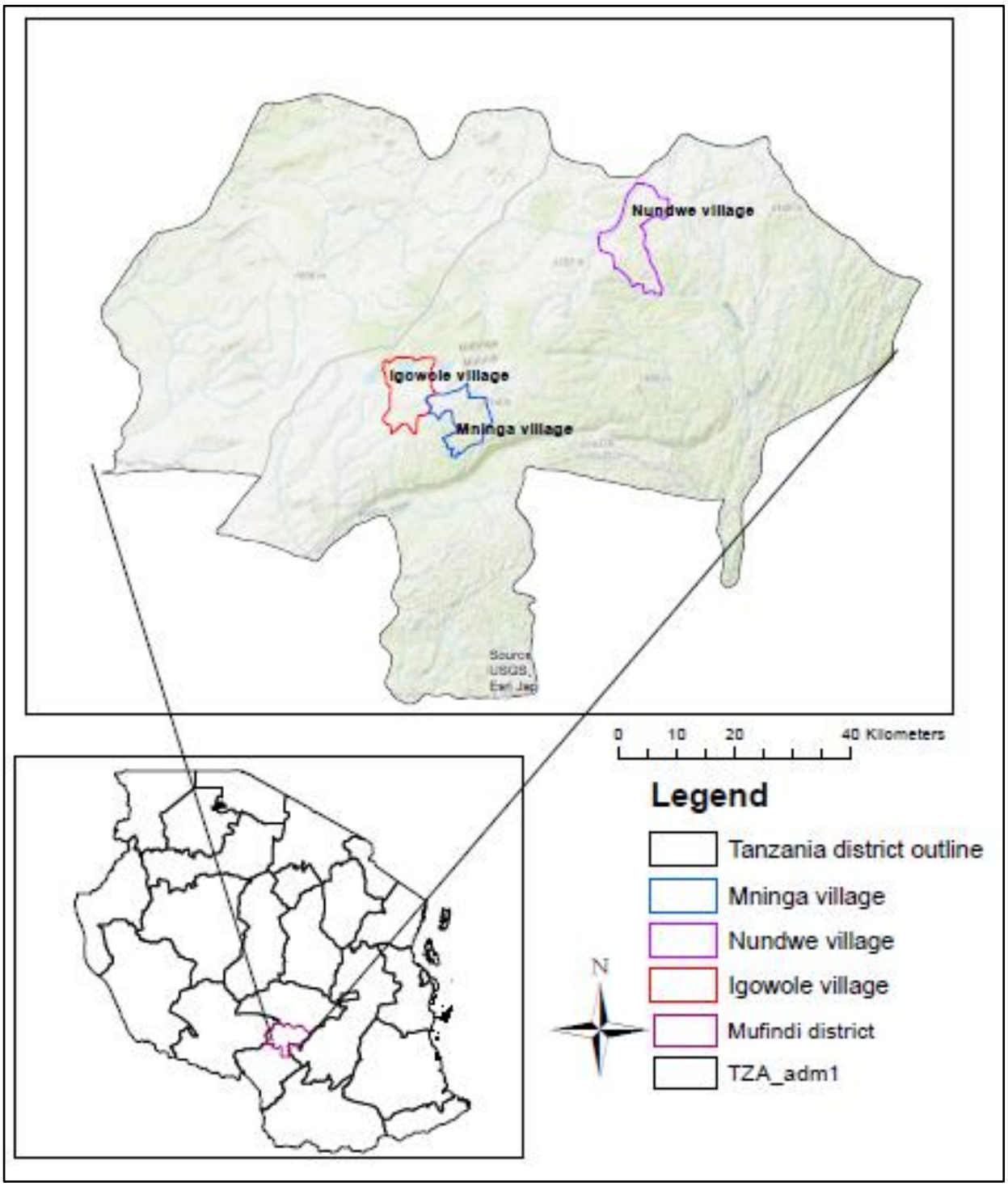
The establishment of forest plantation has taken place in many parts of Tanzania. The history dates back since the 1980s (URT, 2013; Ngaga, 2011). But, only a few districts have reached an advanced stage of forest plantation activities, especially among smallholders and Mufindi district is one of them. Mufindi district is one of the districts with a long tradition of forest plantation activities for both private, state (large scale), and smallholders (woodlots). This research was part of the project known as Wood Cluster project implemented by Institute of International Forestry and Forest Products of TU Dresden in collaboration with Hawassa University in Ethiopia, the Sokoine University of Agriculture in Tanzania and Makerere University in Uganda. The project aims at narrowing the wood supply gap in these eastern African countries by training, conducting researches and establishment village field laboratories for learning and extension

with tree growers. Thus, by using both literature and expert recommendations, Mufindi district, and later Igowole, Mninga, and Nundwe villages were selected for this study.

Therefore, the present study was carried out in Mufindi district council in three selected villages namely: Mninga, Igowole, and Nundwe (Figure 3). These villages were purposively selected based on, first, the existing literature that it has a high prevalence of smallholder woodlot farmers (Tweve, 2016; Ngaga, 2011; Nkwera, 2010). Secondly, based on expert opinion that the area has active organized and unorganized woodlots farmers that have been supported by the various organization, which the present study had interested in. The experts included the Wood Cluster project coordinator at Sokoine University of Agriculture (SUA), student researchers from SUA who had also done their master thesis research in the study area. In addition, relevant local programs, NGOs and public institutions such as PFP, FDT and district forest staffs at Mufindi were equally consulted. On this basis; Igowole, Mninga and Nundwe villages were selected.

3.3 Description of the Study Area

Mufindi District is in Iringa region of the Southern Highland zone of the United Republic of Tanzania (URT). It is about 600 km from Dar es Salaam, the country's commercial city and 80 km from Iringa regional headquarters. The area lies between latitudes 8^{o} and 9^{o} south and longitudes 30^{o} and 36^{o} East. And it is located around 1,900 meters above sea level. The District occupies a total area of about 7,123 square kilometers. Administratively, the district consists of 5 divisions, 28 wards, and 132 villages (Figure 2).



Source: Author, 2018

Figure 2: The map of Mufindi District and case study villages.

The climate of Mufindi district is characterized by the unimodal rainfall pattern with single rain season mainly from November to April. The area receives an average rainfall of 750 mm annually and experiences a dry season from May to October. The lowest temperature on average and highest are around 14^0C and 25^0C respectively. However, June and August are the coldest months of the year, December is the warmest

month of the year on average. The soils in Mufindi district area are generally derived from granite which is deeply weathered and consists of a mixture of red and yellow clay loams with dark humic topsoil (WoodCluster, 2018). There is 203,188 ha of forests, occupying about 28% of the total land area in the district; of these around 66,000 ha are tree plantations of which 65% are Sao Hill Forests and the remaining 35% is occupied by the Mufindi District Council, NGOs, and individuals (URT, 2007).

3.4 Socio-demographic information of Mufindi district

According to the national census of 2012, Mufindi district has a total population of about 265,829 people, of which 53% are females, being the district with the largest population in Iringa region. The district has an estimated 66,058 households with an average household size of 4.2 (National Bureau of Statistics, 2013). Most smallholder farmers are mainly involved in crop farming such as maize, beans, round potatoes, and wheat. But tree planting and management in woodlots has become another most important livelihood activity for smallholder farmers in Mufindi district (URT, 2007; Nkwera, 2010).

Although agriculture is the main economic activity in the district, a shift from agriculture to forestry was observed (Nkwera, 2010). While Singunda (2010) study found that smallholder woodlots in Mufindi district were contributing a share of USD. 125 to USD. 240 to total household incomes per year. Moreover, the national per capita income was USD. 210 and the district per capita income was about USD. 100 in 2006 (Singunda, 2010). In addition to income contribution, forestry activities create job opportunities for communities in the district.

3.5 Demographic information of the studied villages

Villages did not have clear data on a number of households growing trees. However, a Wood Cluster project baseline study shows that 90%, 90% and 85% of households in Igowole, Mninga, and Nundwe villages respectively owned woodlots (WoodCluster, 2018). Since the method of selection of both study site and respondents was purposive, thus snowball sampling was used for selection of respondents (described in the section 3.6.1). The number of tree growers and sampling proportions is given in the table below (Table 1).

Table 1. Demographic information of the study villages

Village name	Males	Females	Population (Total)	Number of households	Woodlot owner households	Samples households	% of sampled households
Igowole	4,320	3,856	8,176	2,274	2,046	24	1.2
Mninga	2,720	3,120	5,840	1,168	1,051	24	2.3
Nundwe	792	883	1,675	660	561	24	4.3

Source: National Bureau of Statistics (2013)

This study sampled an equal number of households from organized and unorganized tree growers. From organized tree growers 12 households were sampled from each tree grower association (TGA). These include ICFG TGA at Igowole and UWAMINU TGA at Nundwe villages. Such sample from TGAs represented 41.4% and 40% in TGA members of ICFG and UWAMINU respectively. According to Aberdeen (2013) and Yin (2006), a minimum sample of 10% is enough to be representative for the study population. Thus, the samples for TGAs are representative and analytical results and inferences were generalized to whole TGA samples in Igowole and Nundwe villages.

3.6 Tree grower associations (TGAs) in the study areas

Private Forest Program (PFP) promoted the establishment of tree grower associations (TGAs) in Mufindi district (WoodCluster, 2018). Formally, several groups for social and savings (revolving fund) existed in Igowole village. In 2009 after PFP promoted tree growers to form groups/associations, the groups united to form one group of tree growers called Muungano TGA with 50 members (WoodCluster, 2018). However, PFP did not maintain contact with them, as the result, the TGA gradually collapsed and continued with their former groups. In 2014, PFP came again, and the tree growers formed another association of tree growers called Igowole community and Family Group (ICFG) TGA, which at the moment has 29 household members (11 females and 18 males). In 2016, PFP facilitated this association by delivering training, seedlings and planting materials. During the fieldwork for this study, registration of ICFG TGA was being processed at the district level. However, it was no longer under active support of PFP but was looking for supporters including applying for grants from TaFF. On the other hand, UWAMINU TGA in Nundwe village was established in 2009 with a fluctuating number of members from time to time. When this study was being conducted, the active members were 30 (11 females and 19 males) (Table 2). UWAMINU was still actively in contact with PFP but not directly with tree planting agenda, but rather on the village savings organization (VSO). Moreover, PFP had trained both TGAs (UWAMINU and ICFG) on savings through revolving funds, to avail alternative sources of money for tree growers to reduce premature tree harvesting tendencies and extend rotations to improve woodlots products quality and profitability.

Table 2. Tree grower associations (TGAs) in the study area

Village	Name of TGA	HH members		Total	Sampled HH	sampled HH (%)	Status	Reg. year
		Males	Females					
Igowole	ICFG[1]	18	11	29	12	41.4	Unregistered	-
Nundwe	UWAMINU[2]	19	11	30	12	40.0	Registered	2012

Source: TGA document files (2018)

[1] ICFG = Igowole community and family group

[2] *Umoja wa wakulima wa miti Nundwe (UWAMINU)* = kiswahili words, translated as 'Nundwe tree growers union'

3.7 Primary data collection

Various data collection techniques were used to collect primary data. These included: snowball sampling and in-depth household interviews, actor and/or institutional interviews, focused group discussion using both structured and semi-structured questionnaires. In additions for woodlots assessment rapid appraisal (RA) approach and direct field observation were used. Before the interview, all questionnaires were translated to Kiswahili, a language spoken by almost everyone in Tanzania. Pre-testing of questionnaires was done on randomly selected respondents. Moreover, the author did data collection with the help of enumerator during the first two weeks, but before we commenced the task discussion was made to familiarize him with questionnaire contents, objectives of the research and type of data needed, research ethics and field approach to respondents.

3.7.1 Social network data collection and snowball sampling

Household respondents were selected purposively involving the active tree growers in the three study villages. Thereafter, the so-called "snowball method" was used to obtain the needed sample of households, that were used to track up their related actors for this study. The following steps were followed when collecting data using snowball sampling techniques: First, focal woodlot farmer was identified with the help of village leaders (village executive officers (VEO) and village chairpersons) for both organized and unorganized smallholder farmers. For unorganized farmers, an active woodlot farmer was obtained and from organized farmers, TGA leaders were the initial focal persons both recommended by the village leaders. Second, each of the identified focal farmers was interviewed and then, requested to name other actors (tree grower, nursery operator, institutions and NGOs) and their relationships. Thirdly, all the actors named (who were not part of the list chosen by village leaders) were tracked down and up, interviewed and asked for all their tiers again. The process continued until the study predetermined sampling size at household level was reached, and until all institutional actors were exhausted. Usually, the process would continue until no further actor is found or no new information is generated (Claridge, 2004), yet in this case, time and financial resources constraints were the main limiting factor for this study to reach full data saturation. Thus, the present study limited the number of household/farmer actors to a total of 24 in each village. That means 12 households from organized and 12 from unorganized farmers. However, this number was deemed adequate, as it represents more than 10% of the study population of the organized (TGA members), but non-representative for the tree grower households for the whole village for each village in the study areas. Furthermore, in Mninga village, all 24 smallholder farmers interviewed were from the unorganized group as there are no organized farmers existed in this village.

The snowball methods were being particularly useful for tracking down "special" subjects or actors of interest such as; business contact networks, community elites, deviant sub-cultures, avid stamp collectors,

kinship networks, and on effectively locating and describing many other structures (Claridge, 2004). However, Claridge (2004), warns of two major potential limitations and weaknesses of snowball methods, namely; First, isolated actors or actors who are not connected may not all be located by this method. That means the presence and numbers of isolates, therefore, can negatively affect the generalization of the results to a wider population. Second, there is no guaranteed way of finding all the connected individuals in the population. For example, where to start the snowball rolling? If it starts in the wrong place or places, it is more likely to miss whole sub-sets of actors who are connected but not attached to our starting points. However, these methods can be strengthened by giving some thought to how to select the initial nodes. In community power studies, for example, it is common to begin snowball searches with the chief executives of large economic, cultural, and political organizations (Dempwolf et al., 2012; Darr, 2008; Claridge, 2004). Similarly, in the present study, we started with the village executive officers (VEO) and village chairpersons to seek information to locate the actors. According to Claridge (2004), the approach is very likely to capture the elite network quite effectively. It should be noted that the sampling frame in the present study consisted of woodlot farming households only. Therefore, including the 24 households in each study village, a total of 31, 32 and 35 actors were identified and interviewed for social network data in Igowole, Mninga, and Nundwe villages respectively.

3.7.2 In-depth household interviews

An in-depth interview was carried out simultaneously from a snowball sampled tree grower households to collect primary data related to tree growing activities and their relations. Thus, the in-depth interviewing task was carried out to a total of 72 households, meaning that 24 households in each of the three study villages. But for Igowole and Nundwe villages, 12 households were TGA members (organized) and 12 non-TGA members (unorganized) in each village. While for Mninga village, all the 24 households were unorganized because all tree growers were non-organized in this village. The interview was based on the semi-structured questionnaires using both open and closed-ended questionnaires giving room for an interviewee to express freely to obtain more information.

3.7.3 Rapid Appraisal of woodlots performance

Rapid Appraisal (RA) is an approach that draws on multiple evaluation methods and techniques to quickly, yet systematically, collect data when time in the field, financial budget and reliable sources of secondary data are limited (USAID, 2010). No empirical data about farmers woodlots performance in the study area was available in the current literature. In addition, time for data collection was limited to only three months between March and June 2018 not enough to carry out complete woodlots inventories. Coupled with fund limitations, thus the present study employed RA methods to collect woodlot performance data.

Before RA task, six assessment criteria were established by the researcher. These criteria included: (1) Gabs; which aimed to assess the survival of planted seedlings revealed by missing trees as most woodlots trees were planted in defined planting lines and space. (2) Woodlot cleanliness; which included the evaluation of management practices including weeding and fire protection (fire line space and clearing). (3) Bole quality; which assessed pruning practice (was done or not), the impacts of previous pruning practices and competition effects. (4) Planting space, which assessed the right planting at a reference of (3 x 3) meters spacing. (5) Growth condition; that determined history of fire damages, competition due to short planting distance, lack of thinning practice as well as poor site quality (infertile soil). And (6) Pest attack; that evaluated the presence of damages and/or abnormalities caused by diseases and insect damages. Then, a combination of methods including measurements, interview with woodlot farmer and researcher's direct observation were used. Thereafter, a performance score value based on Likert scale (1 = good, 2 not good performance) were awarded for each established criterion to determine the performance.

In total 72 woodlots were assessed in three villages including Igowole, Mninga, and Nundwe. However, all 24 woodlots at Mninga village were from unorganized farmers[3], because there were no organized farmers in this village to act as a control group for unorganized farmers.

3.7.4 Focused group discussion and Key informant interviews

Focus group discussion was conducted at the village level with TGAs leaders, a few TGA members and nursery operator farmers. One focused group discussion was held each in Igowole and Nundwe villages. While key informant interview was done with all organizations and institutions which were mentioned to had supported tree growers both individually during in-depth household interviews and focused group discussions with tree growers, nursery operators and TGA leaders in the study villages. The list of actors was obtained that included: Mufindi district council, PFP, FDT and TaFF and all were visited and interviewed using the pre-prepared questionnaires.

3.8 Secondary data sources

This study reviewed a number the relevant published and unpublished literature on smallholder farm forestry locally, nationally, regionally and globally. Also, documents such as group constitutions, guidelines from organizations, reports, and seminars were reviewed and adequately cited and referenced. All these reviewed literature constituted secondary data sources and were equally important for enriching data, standardization, and validation of the findings as well as a comparison against the work of other scholars.

[3] Unorganized farmers: farmers who non-member of the tree grower association (TGA)

3.9 Ethical considerations

Prior to field data collection, the researcher introduced himself first to Sokoine University of Agriculture (SUA), a TU Dresden partnering university in Tanzania, under the Wood Cluster project in which this research was carried out. While at SUA, the researcher contacted the wood cluster project coordinator, research co-supervisor and applied for research student associateship to the SUA Directorate of Postgraduate Studies, Research, Technology Transfer and Consultancy where he got issued with a consent to conduct research under SUA co-supervision. While at Mufindi district, the researcher introduced himself to the district council management, then the district council wrote an introduction letter to all three research villages, NGOs and institutions working with smallholder tree growers to grant cooperation during the study period. Finally, the researcher introduced himself to all interview respondents as a master student of TU Dresden and research student associate of SUA. All respondents were told about their roles, methods used in data collection, information confidentiality, and their rights to terminate their participation. Participants were guaranteed that the data collected would only be used for thesis production and/or for academic publication. Also, hard woodlots access due to rainy and slippery routes (Figure 27, Annex 4).

3.10 Materials and instruments for data collection

Global Positioning System (GPS) for picking coordinates of assessed woodlots to determine locations. This information was useful for during analyzing social networks and woodlots performance to examine the effect of the actor's distance and elevation of woodlots performance. In addition, a tape measure was used for mearing tree planting spaces and a camera was used for field photograph taking.

3.11 Data analysis

Descriptive statistics

Quantitative data were analyzed by descriptively by using IBM SPSS Statistics version 20 software and excel spreadsheets. Results are summarized in tables and graphs.

Logistic regression analysis

Logistic regression analysis of the R software was used in the analysis, to test if there is a significant difference or not in woodlots performance between unorganized and organized farmers. Such analyses were necessary to ascertain the impacts of support organizations on farmers woodlots. It assessed the relationship between dependent variables (TGA membership, household size) and independent variables (Gaps, Growth condition, planting space, Bole quality, and Woodlots cleanliness). The analysis parameters of estimation included: standard error (Std Error), t-value, significance level (P-value) as well as minimums and maximum values. However, the choice of a parameter to be used to interpret model results differs across disciplines (Dytham, 2011). But also, it depends on the researcher preference. In the present study, the level

of significance (P = 0.05) was used to interpret the model results. In fact, the general observation was that most support organizations and institutions preferred more to support organized farmers through their TGAs than individual farmers.

Social Network Analysis (SNA)

Social network data were analyzed using the R software (R – studio). Different network tiers of the actors were linked to resources, information and technology ensured through the provision of seeds and seedlings, funds, training, communication, and information sharing and contracts to farmers from different support organizations and among farmers themselves were analyzed. The analyzed results were presented in sociogram graphs and network information in tables. The analyses were based on a list of all actors identified and interviewed in the three study villages. Using both the list of organizations and farmers, structured and semi-structured questionnaires were used to find out the woodlot farmers connectivity to their supporting organizations.

CHAPTER FOUR

4. RESULTS

This chapter presents the research findings. It describes relevant socioeconomic characteristics of the respondents and other findings based on the research questions. In total 92 respondents were interviewed including 72 woodlot owners whose woodlots were assessed for performance, 14 tree nursery operator farmers, one NGO, namely Forestry Development Trust (FDT), one bilateral program - Private Forestry Program (PFP), one public institution - Mufindi district council (MDC), two public agencies; Tanzania Forest Fund (TaFF) and Tanzania Forest Services (TFS) the owner of Sao Hill plantation forest, and two tree grower associations (ICFG at Igowole and UWAMINU at Nundwe).

4.1 Socio-economic characteristics of assessed woodlots farming households

4.1.1 Level of education of the woodlots owners

Pertaining to the highest level of education of the woodlots owners, Mninga village had the highest percentage of respondents with primary education (91.7%) while Igowole and Nundwe had some respondents with secondary education (25% and 12.5%) respectively. (Table 3).

Table 3. Percentage of woodlots owners by highest educational levels

Education levels	The Village of respondent		
	Igowole (n = 24)	Mninga (n = 24)	Nundwe (n = 24)
No formal education	0%	4.2%	0%
Primary	70.8%	91.7%	87.5%
Secondary	25%	0%	12.5%
Vocational	4.2%	0%	0%
Tertiary	0%	4.2%	0%
Total (%)	**100**	**100**	**100**

In general, for all the three study villages, all respondents in Igowole and Nundwe and 95.8% of respondents in Mninga had attained formal education.

4.1.2 Age of the woodlots owners

Regarding age of the woodlots owners, Nundwe village had the more percentage of woodlot owners aged between (40 – 50) years (45.8%), while at Igowole and Mninga villages large percentage (33.3% and 41.7%) respectively of the woodlot owners were aged between (31 to 40) years (Table 4).

Table 4. Percentage of woodlots owners by age classes in the study villages.

Age class (years)	The Village of respondent		
	Igowole (n=24)	Mninga (n = 24)	Nundwe (n = 24)
18 – 30	0%	4.2%	4.2%
31 – 40	33.3%	41.7%	20.8%
41 – 50	25.0%	16.7%	45.8%
51 – 60	25.0%	20.8%	29.2%
> 60	16.7%	16.7%	0%
Total (%)	**100**	**100**	**100**

4.1.3 Gender of the woodlot owners

Much more male, 100%, 87.5%, 79.2% in Igowole, Mninga and Nundwe villages respectively owned woodlots (Table 5). Only 12.5% and 20.8% of woodlots owners in Mninga and Nundwe respectively were females. The reason behind this may be because, woodlot establishment, planting, harvesting and selling activities are labor intensive and mostly done by men and women play a supporting role. Another reason could be due to the fact that woodlots ownership is related to land ownership. As a matter of fact, traditionally, land in this region is owned by men, similar to finding by Nkwera (2010).

Table 5. Percentage of woodlots owners by gender

Gender	Village of respondent		
	Igowole (n=24)	Mninga (n = 24)	Nundwe (n = 24)
Male	100%	87.5%	79.2%
Female	0%	12.5%	20.8%
Total (%)	**100**	**100**	**100**

4.1.4 Woodlots owners household size

Regarding household size of the woodlots owners, the largest percentage (79.2%, 62.5%, and 58.3%) of households in the three study villages Nundwe, Igowole, and Mninga villages respectively had the largest household size (5 – 8) persons per household., While 25% of respondents in Igowole and Mninga villages and 16.7% in Nundwe village had (1- 4) persons per household. (Table 6). In addition, household size has a significant influence on woodlots performance. Statistical test using regression analysis of the R software ($P = 0.05$) for woodlots performance and household size revealed a significant difference ($P = 0.0199$) (Table 29, in section 4.5). That means, household size direct proportionally affects woodlots performance.

Table 6. Household size of the woodlot owners

	Village of respondents		
Number of persons	**Igowole (n = 24)**	**Mninga (n = 24)**	**Nundwe (n = 24)**
1 – 4	25%	25.0%	16.7%
5 – 8	62.5%	58.3%	79.2%
9 – 12	12.5%	16.7%	4.2%
Total (%)	**100**	**100**	**100**

Nevertheless, to determine how much labor did the household have for woodlots, household size for the people aged more than 5 years was evaluated in each of the study village and results presented (Table 7). Again, Nundwe village had largest percentage (66.7%) of household members aged greater than 5 years with (5 - 8) members, followed by Igowole (54.2%) and then Mninga (41.7%).

Table 7. Household size for members aged more than 5 years

Village	Household size (>5 years)	Percent (n = 24)
Igowole	1 - 4	33.3
	5 - 8	54.2
	9 - 12	12.5
Mninga	1 - 4	41.7
	5 - 8	41.7
	9 - 12	16.7
Nundwe	1 - 4	29.2
	5 - 8	66.7
	9 - 12	4.2

4.2.5 Household source of labor

It was observed that 66.7%, 54.2%, and 41.7%, of the respondents in Igowole, Mninga and Nundwe villages, respectively were using exclusively family labor (Table 8). Nundwe with 45.8% of respondents combining family and hired labor were the highest compared to 20.8% and 33.3%, Igowole and Mninga respectively. Conversely, hired labor was the same in all three study villages. Thus, family labor as the main source of labor for all the villages in the study area.

Table 8. Household sources of labor

Source of labor	Igowole (n = 24)	Mninga (n = 24)	Nundwe (n = 24)
Family	66.7%	54.2%	41.7%
Hired	12.5%	12.5%	12.5%
Family and hired	20.8%	33.3%	45.8%
Total (%)	**100**	**100**	**100**

4.1.6 Cost of hired labor

Two categories of payment methods for hired labor were identified. These included payment per day and payment per hectare (ha). More tree growers were hiring labor per day and it cost between USD (2.2 to 3)

per laborer per day. It was found that one person needs about ten (10) days to finish one hectare of pitting and planting. A man-day for hired labor was equivalent to about 6 hours of work, normally from about 8:00 am to 2:00 pm. Therefore, working on a hectare of woodlot would cost between USD (22 to 30) when labor is hired on daily basis. Only a few (2.8%) of the interviewed woodlots owners hire labor and paid per hectare. The cost for a one-hectare working cost between USD (26.1 to 32.6) (Table 9).

Table 9. Cost of hired labor (USD) for pitting and planting per day

Descriptive statistics				
Cost for hired labor (USD)	**Frequency (n = 72)**	**% (n = 72)**	**Minimum**	**Maximum**
Cost for hired labor per day	22	30.6	2.2	3.0
Cost for hired labor per (ha)	2	1.4	26.1	32.6

Woodlot farmers preferred to hire labor daily. According to interview respondents, the reasons for this was because of the easy supervision and the ability of the woodlot owner to assign other tasks to a laborer per man-day. On the other hand, the cost for hired labor per ha was found to be USD 32.6, a little higher than hiring and paying per day. In fact, this makes little difference from hiring and paying per day because daily payment is accompanied by supplying food to the laborer (s) which covers the little cost differences. The daily payment system was mostly used by the farmers who are always available at the site and they worked together with the hired person. Activities involved were mostly land preparation, pitting, planting, and pruning.

4.1.7 Sources and cost of seedlings for tree planting

Pertaining to sources of seedlings for household tree planting, in Mninga village largest percentage (95.8%) of respondents were buying tree seedlings from tree nursery operator farmers in the village. While a larger percentage of respondents in Igowole and Nundwe (37.5% and 50%) respectively were getting tree seedlings from TGAs. Seedlings from TGA were raised from improved seeds donated by support organizations through their TGAs (Table 10).

Table 10. Sources of tree planting seedlings, the study villages

Source of seedling	Igowole (n = 24)	Mninga (n = 24)	Nundwe (n = 24)
Purchase	45.8%	95.8%	41.7%
Tree Grower Association (TGA)	37.5%	0	50%
TGA and purchase	12.5%	0	0
Raised/tree nursery	4.2%	4.2%	8.3%
Total (%)	**100**	**100**	**100**

***TGA = tree grower association**

The largest number of nursery operator farmers sold tree seedlings at the price between USD (0.02 – 0.06) (Table 11). Most of the nursery operator farmers used seeds collected from mature trees mainly from Sao

Hill plantations. However, the quality of the collected seeds was not known but rather relied on the ability of the seeds to germinate.

Table 11. The price range of seedlings (USD) in the study area

Price per seedling (USD)	Price range (USD)	Igowole (n = 24)	Mninga (n = 24)	Nundwe (n = 24)
0.04	0.02 – 0.06	70.8%	91.7%	41.6%
0.10	0.07 – 0.12	8.3%	4.2%	4.2%

Interview with TGA leaders at Igowole and Nundwe found the that Igowole community and family group (ICFG) TGA had received Pine (2kg), Eucalypt (1Kg) seeds and polythene tubes (10Kg) for nursery seedlings management from Private Forestry Program (PFP) in 2017, which they had raised and planted in the season (January – March) of 2018. Interview with PFP mentioned that they had bought seeds from (TTSA) – Iringa, a country's certified tree seed supplier. While at Nundwe, the Umoja wa Wakulima wa Miti Nundwe (UWAMINU) TGA, received seedlings from Forestry Development Trust (FDT) organization in 2016, and funding for tree planting from TaFF in 2012 and 2017 to facilitate purchase seeds and planting materials. From the funding, they bought seeds from TTSA – Iringa. That means since 2012 to 2018 UWAMINU TGA members were able to jointly raise seedlings using improved seeds.

4.1.8 Landholding, and land allocated for woodlots for sampled households

Based on these study respondents, descriptive statistics results show that Nundwe village had the largest household landholding by average with 15.9 ha, followed by Igowole with 6 ha and lastly Mninga with 2.8 ha Similarly, land allocated for woodlots, Nundwe had 9.86 ha, while Igowole had 3.7 ha and Mninga 1.7 ha on average. Also, a total of 89.8 ha, 68.94 ha, and 48.87 ha of woodlots were assessed in Igowole, Nundwe and Mninga villages respectively. Nundwe village had the largest mean size of assessed woodlots with 2.9 ha (Table. 12).

Table 12. Descriptive statistics for household landholding, total woodlot sizes, and area of assessed woodlot (ha)

Village		Descriptive statistics						
	Description	N	Range	Minimum	Maximum	Sum	Mean	Std
Igowole	All land (ha)	24	39.0	1	40	144.5	6.02	1.835
	All woodlots (ha)	24	23.9	0.4	24.3	89.8	3.74	1.122
	Assessed woodlot (ha)	24	24.1	0.2	24.3	48.87	2.04	4.850
Mninga	All land (ha)	24	10.5	0.5	11	67.5	2.81	0.487
	All woodlots (ha)	24	6.7	0.2	6.9	41.1	1.71	0.320
	Assessed woodlot (ha)	24	3.9	2	4.1	18.98	0.80	0.88
Nundwe	All land (ha)	24	64.5	0.5	65	382.5	15.94	4.310
	All woodlots (ha)	24	40.3	0.2	40.5	236.6	9.86	2.671
	Assessed woodlot (ha)	24	15.99	0.2	16.2	68.94	2.90	4.550

In addition, a Wilcoxon test (P = 0.05) was done to see if there was a significant difference or not in landholding between organized and unorganized woodlots farmers. The results reveal that there was no significant difference (P = 0.058) in Igowole. While, at Nundwe village, the difference was significant (P = 0.037). This was due to the large land holding and land allocated for woodlots (land holding = 15.94 ha and woodlot = 9.86 ha). While no comparison was made at Mninga village because all farmers were unorganized (Figure 3).

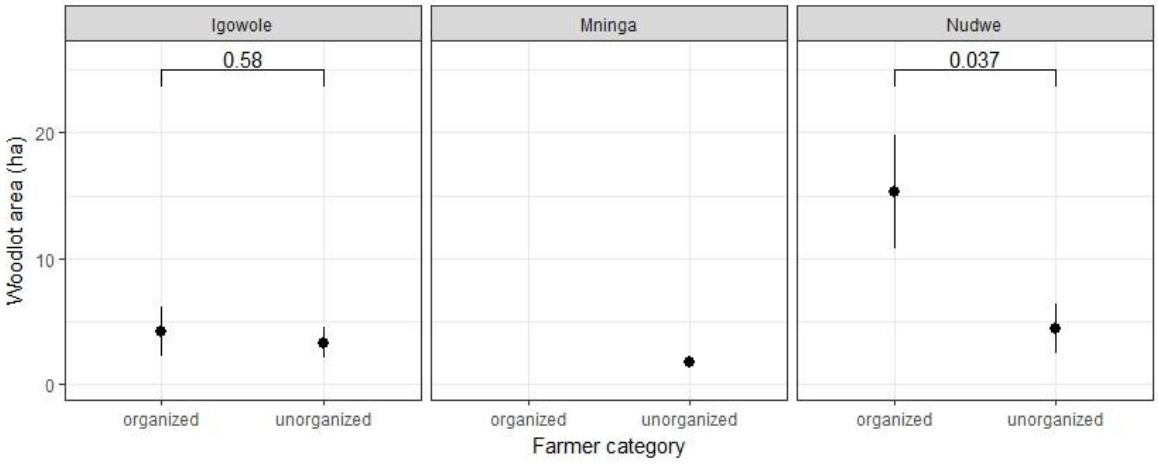


Figure 3. Wilcoxon test between woodlot area and farmer's category

4.1.9 Household plans to plant trees in future and source of land

Regarding the households' source of land for future tree planting, Mninga village had the largest percentage (58.3%) of respondents who expected to buy land for future tree planting, followed by Igowole (45.8%). While at Nundwe villages, the largest percentage of respondents (41.7%) expected to use family land (Table. 13).

Table 13. Source of land for future tree planting in the study villages

Source	The village of the respondent		
	Igowole (n = 24)	Mninga (n = 24)	Nundwe (n = 24)
Inheritance	4.2%	4.2%	12.5%
Buying	45.8%	58.3%	33.3%
Renting	4.2%	0%	4.2%
Family land	33.3%	25%	41.7%
Replanting after harvesting	12.5%	12.5%	8.3%
Total (%)	**100**	**100**	**100**

4.1.10 Residence and main occupation of the woodlot owner

All respondents in Igowole and Nundwe and 95.8% in Mninga were residents in their villages (Table 14), while 4.2% of the respondents from Mninga villages were non-residents that were reported a civil servant who worked in Ruvuma region and had come for a leave.

Table 14. Percentage of respondents by residence and main occupation in the study area

Residence	The village of the respondent		
	Igowole (n = 24)	Mninga (n = 24)	Nundwe (n = 24)
Resident	100%	95.8%	100%
Non-resident	0%	4.2%	0%
Occupation			
Farmer	87.5%	95.8%	100%
Casual laborer	12.5%	0%	0%
Public servant	0%	4.2%	0.0%

4.2 Farmer's motivations, knowledge base and challenges for tree growing in woodlots

4.2.1 Farmer's motivations to plant and manage trees

Regarding smallholder farmers motivations to plant and manage trees in woodlots, in all three villages the main motivation was economic related motivation by 51%, 48% and 45% of respondents in Nundwe, Igowole, and Mninga respectively (Table 15). Economic motivations included financial returns from currently timber selling farmers, investing for the future generation, as a form of saving and as a business.

Table 15. Motivations of farmers to plant trees in the study area.

Motivation category	Real motivations	Igowole (n = 24)	Mninga (n = 24)	Nundwe (n = 24)
Economic	Financial returns from current timber sale by other farmers, investing for the future generation, a form of saving and as a business	48	45	51
Tenure	Land security	37	30	31
Environmental	Soil fertility improvement	11	16	9
	Conserve environment	0	0	7
Socio-economic	For prestige as a sign of wealth and reduce the risk of crop damages	4	9	2
Total (%)		**100**	**100**	**100**

4.2.2 Farmer's knowledge to plant and manage trees

In relation to which knowledge farmers had about tree planting and management, the results revealed that in all three villages most tree growers (75 – 100) % of respondents had knowledge about land preparation, tree planting, weeding, pruning, and fire protection. While 75% of respondents had nursery seedling production knowledge at Nundwe village, only 20.8% and 33.3% of tree growers had the same at Mninga and Igowole villages respectively (Figure 4). However, tree growers did not say anything about the best rotation period and when exactly to harvest trees in their woodlots, which means this knowledge is missing.

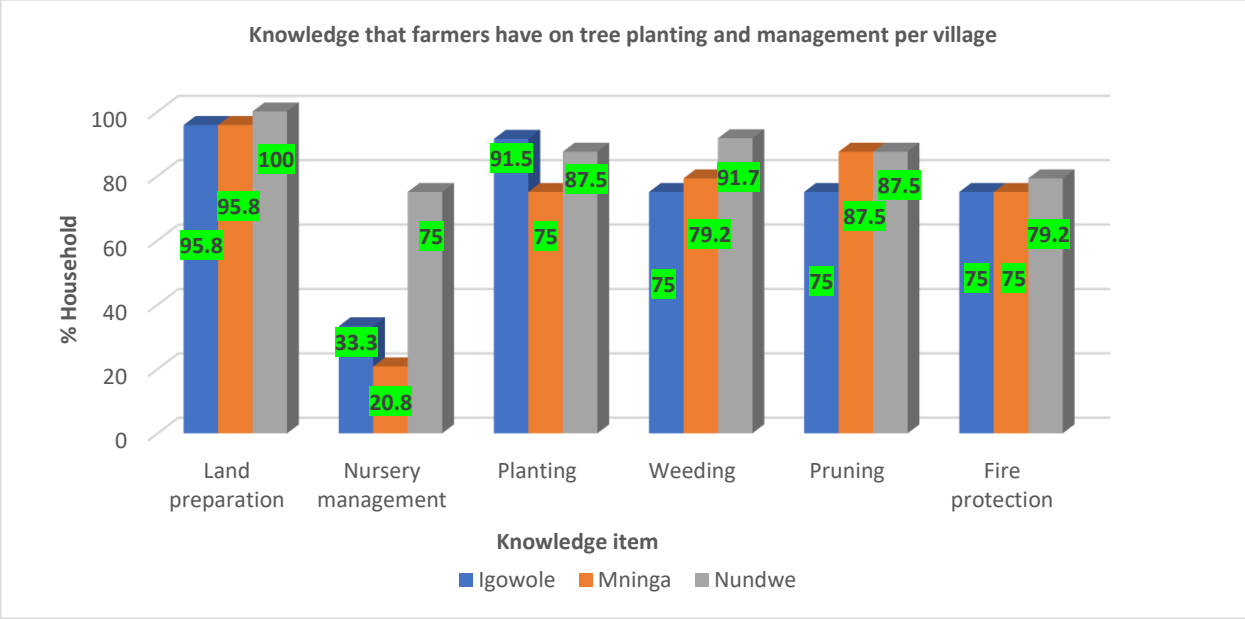


Figure 4. Farmer's knowledge to plant and manage trees in the study villages.

In addition, physical measurement of the tree planting space was taken during rapid appraisal exercise to assess woodlots performance. The results revealed variations in tree planting space among different farmers who, the majority of them mentioned to have a tree planting knowledge. For unorganized farmers at Igowole and Nundwe villages, the largest percentage (45.8%) of respondents had planted trees at (2 – 2.5) meters planting space, and 33.3% had planted at planting space (2.6 - >3) meters (Figure 5).

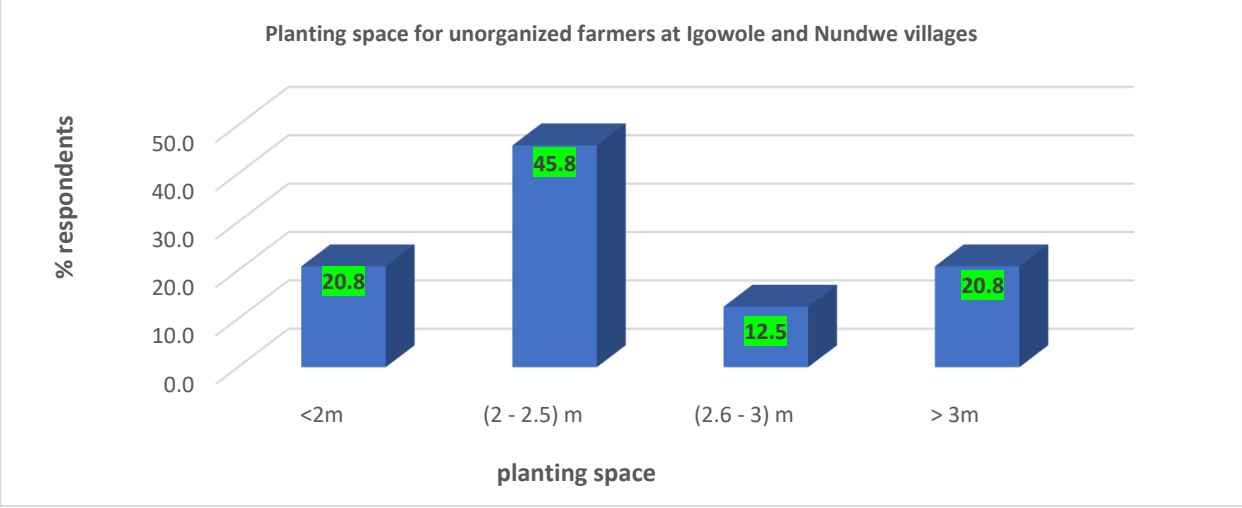


Figure 5. Woodlot trees planting space for unorganized farmers in Igowole and Nundwe villages

On the other hand, the largest percentage of the organized farmers at Igowole and Nundwe villages (41.7%) had planted trees at spacing of between (2 – 2.5) meters, while 50%% had planted at space (2.6 - > 3) meters and 20.8% had planted at (<2) meters spacing (Figure 6).

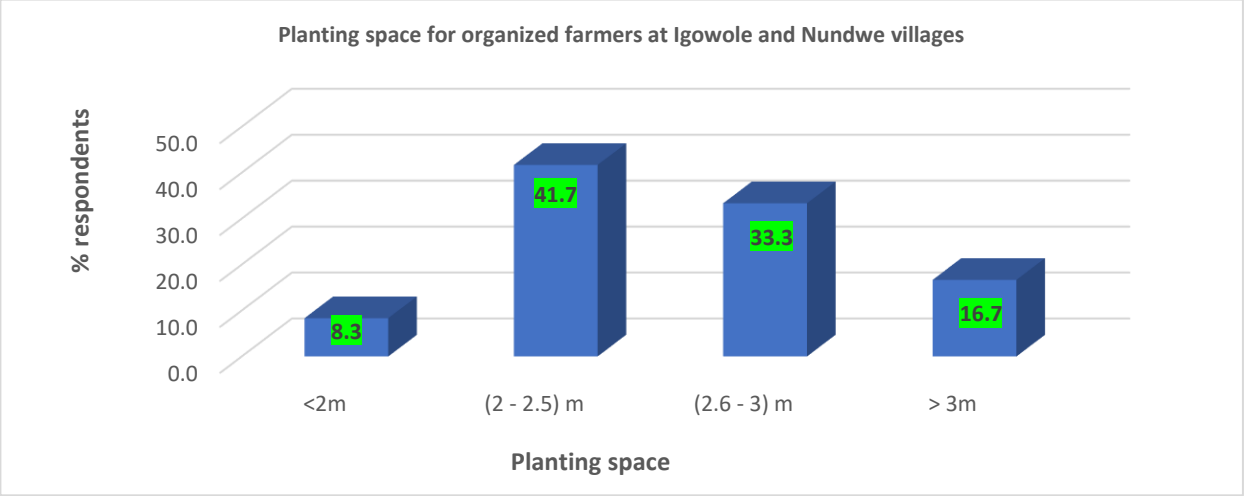


Figure 6. Woodlot trees planting space for organized farmers in Igowole and Nundwe villages

Nevertheless, all farmers at Mninga villages were unorganized and largest percentage (50%) of respondents had planted tree at spacing of 2 to 2.5 meters, while 41.7% had planted at 2.6 to 3 meters and 8.3% had planted at greater than 2 meters spacing for pines which were mainly planted for sawn timber production (Figure 7). But, according to the Forest Plantation and Woodlot Technical Guidelines of Tanzania, the set standard planting space for pines in Mufindi district is 3 x 3 meters for trees planted for sawn timber production (URT, 2017).

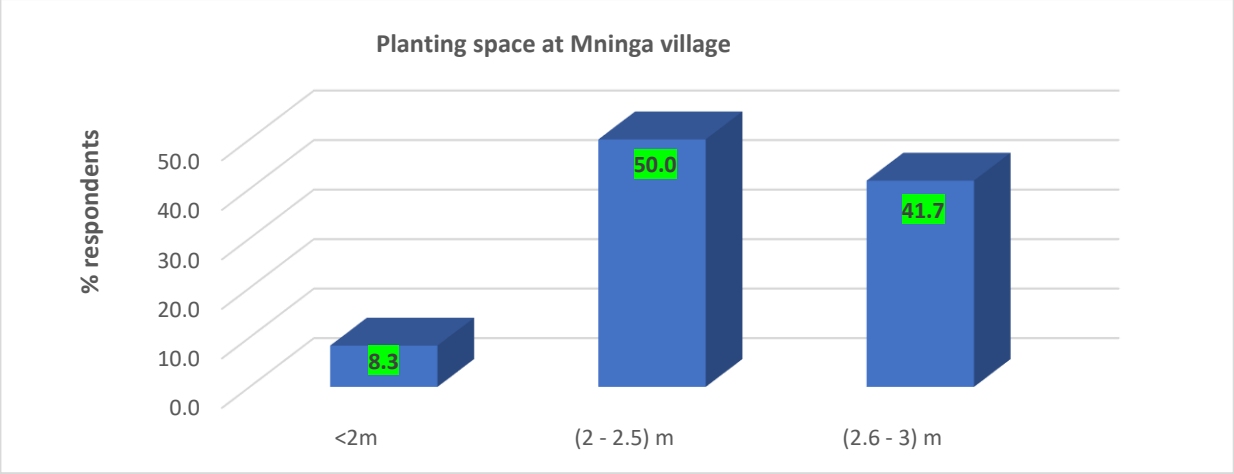


Figure 7. Woodlots trees planting space at Mninga village (all unorganized farmers)

The differences in planting spaces between a different group of tree growers are attributed to lack of practical knowledge as most of them received theoretical training and inability to use proper measurement tools. For example, most tree growers were measuring meters by pace stepping.

4.2.3 Source of knowledge to plant and manage trees for unorganized farmers

The results from the present study showed that 41.7% of respondents received tree planting and pruning knowledge from Sao Hill, while the rest of the knowledge items (land preparation, planting, fire protection, weeding, and pruning) (33.3 - 37.5) % were gained from other farmers and from their own experience. While a little proportion (4.2 – 8.3) % received nursery management knowledge and other knowledge items from Mufindi district council (Figure 8). This could be due to lack of other sources of knowledge for unorganized farmers, as while a few farmers or members of their households had worked at Sao Hill plantations.

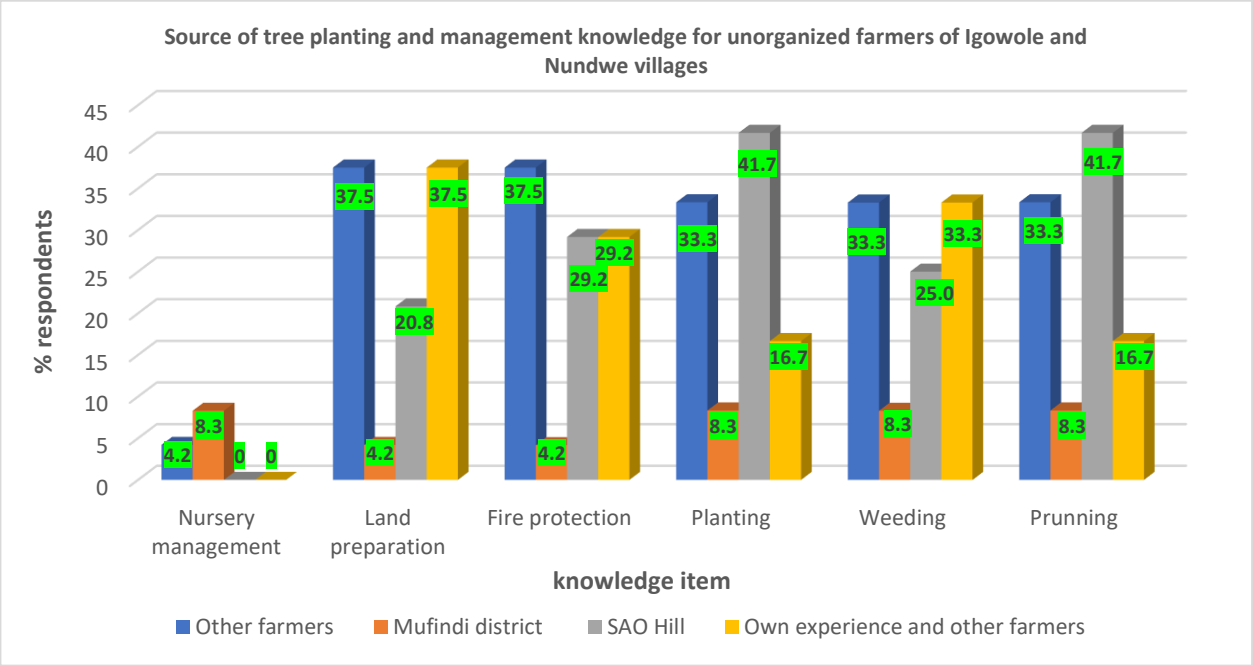


Figure 8. Source of knowledge to plant and manage trees for unorganized farmers at Igowole and Nundwe villages

4.2.4 Source of knowledge to plant and manage trees for organized farmers

Most respondents (62.5 – 75) % from organized woodlots farmers at Igowole and Nundwe villages obtained their tree planting and management knowledge from tree grower associations (TGAs). While (4.2 – 25) % respondents obtaining knowledge either from Sao Hill or TGAs and other farmers (Figure 9). But TGAs members received knowledge through training facilitated by support organizations. For example, UWAMINU TGA at Nundwe villages had several support organizations that supported for training and other services including nursery materials, seeds, and funds. These organizations included the Private Forestry Program (PFP), Forestry Development Trust (FDT), Tanzania Forest Fund (TaFF) and Sao Hill.

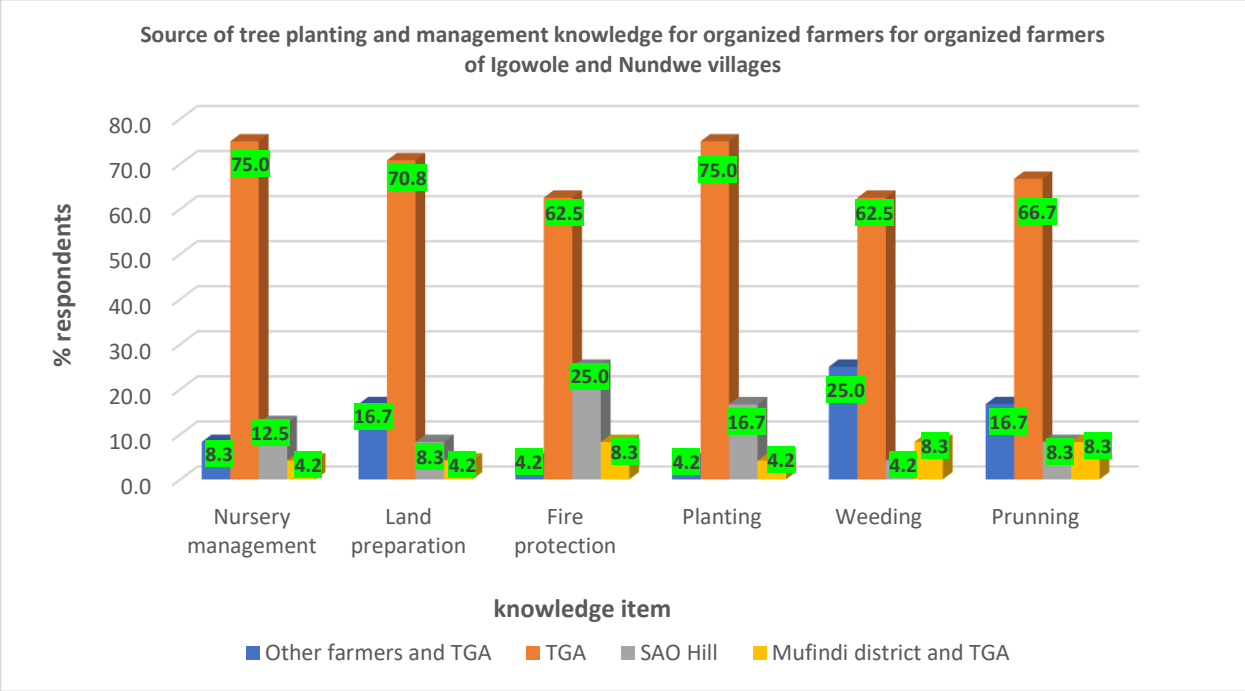


Figure 9. Source of knowledge to plant and manage trees for organized farmers at Igowole and Nundwe villages

4.2.5 Source of knowledge for tree growers to plant and manage trees at Mninga village.

Based on the study respondents, most farmers at Mninga village obtained their knowledge from Sao Hill government plantation forest, whereby the largest percentage (62.5%) got fire protection and pruning knowledge. Sao Hill has an extension department responsible for training smallholders in the neighboring villages. Some respondents obtained knowledge from other farmers for example, up to 45.8% of respondents received land preparation knowledge from other farmers. And a few other respondents (20.8%) had obtained knowledge from Forestry Development Trust (FDT) and Mufindi district council (MDC) which was mainly nursery management knowledge (Figure 10).

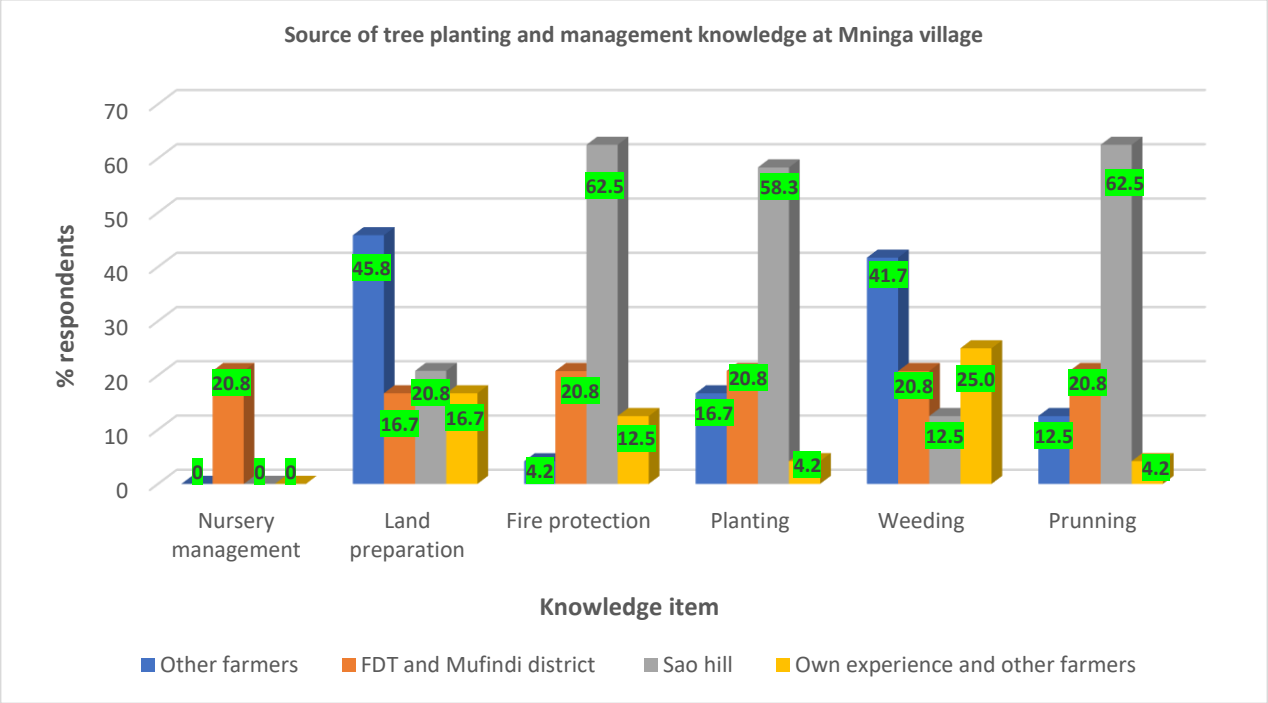


Figure 10. Source of knowledge to plant and manage trees at Mninga village.

4.2.6 Challenges that constrain farmers in growing and managing trees

The present study presented eight (8) challenges that farmers are facing in woodlots farming in the three study villages. The results are summarized and presented in the graph (Figure. 11).

The results indicated that fire was the first and biggest challenge, ranked the highest (87.5% – 100%) in all three study villages Igowole, Mninga, and Nundwe villages. But in Mninga village, inadequate knowledge and lack of improved was mentioned by largest percentage 75% and 95.8% of respondents respectively. While at Mninga village, the largest percentage of respondents (79.2%) mentioned land scarcity as an important challenge. Regarding low prices for sawn timber and standing trees, Igowole village had the highest percentage of respondents who mentioned it (Figure 11).

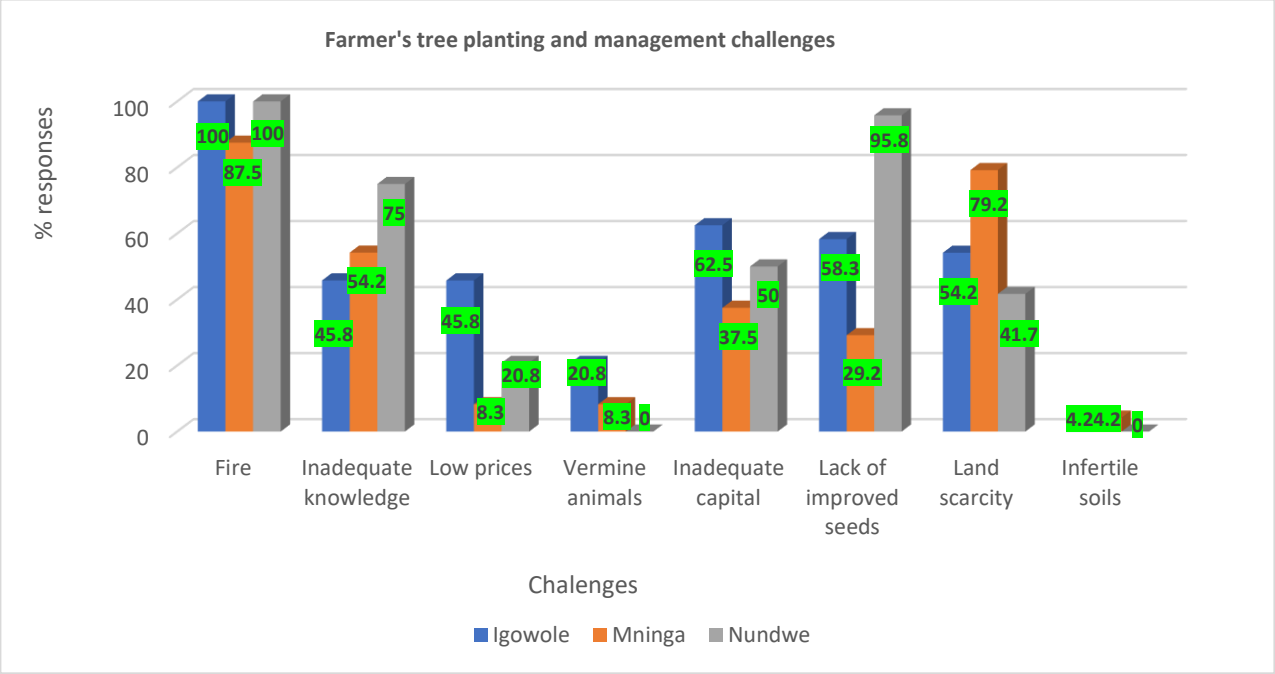


Figure 11. Challenges constraining farmers in planting and managing trees

4.2.7 Tree grower's means to counteract woodlots management challenges

Regarding the tree grower's means to tackle the woodlot establishment and management challenges for each study village, the analysis was made, and the results presented in the tables below (Table 16, 17, 18).

Table 16. Current means for farmers to counteract challenges at Igowole Village

Challenge	Current means to tackle challenges	Responses (%)
Fire	Fireline clearing	100
Inadequate knowledge	TGA registration	25.0
	From other farmers	25.0
	Sao Hill	8.3
Inadequate capital	Savings groups	16.7
	Other farmers	8.3
	Bank loans	20.8
	Early harvesting of trees	12.5
Lack of improved seeds	Planting locally collected seeds from old trees	29.2
	TGA and from locally collected	25.0
Land scarcity	Buying	37.5
	Rent	8.3
	Inheritance	8.3
Infertile soils	Planting Pinus spp.	4.2

Table 17. Woodlots farmers ways to counteract challenges at Mninga Village

Challenge	Current means to tackle challenges	Responses (%)
Fire	Fireline clearing	87.5
Inadequate knowledge	From other farmers	25.0
	Sao Hill	54.2
Inadequate capital	Other farmers	20.8
	Early harvesting of trees	16.7
Lack of improved seeds	Planting locally collected seeds from old trees	25.0
Land scarcity	Buying	50.0
	Intercropping	37.5
Infertile soils	Planting Pinus spp.	4.2

Table 18. Woodlots farmers ways to counteract challenges at Nundwe Village

Challenge	Current means to tackle challenges	Responses (%)
Fire	Fireline clearing	100
Inadequate knowledge	TGA registration	45.8
	From other farmers	37.5
	Sao Hill	12.5
Inadequate capital	Other farmers	4.2
	Selling crops and asserts	8.3
	Joint working	25.0
	TGA registration	25.0
Lack of improved seeds	TGA registration	4.2
	Planting locally collected seeds from old trees	4.2
Land scarcity	Buying	20.8
	Intercropping	16.7
	Renting	4.2
	Intercropping	12.5

4.3 Farmer's tree species preferences, products, and woodlots performance

4.3.1 Farmer's preferred and planted tree species

Pertaining to woodlots farmers preferred and planted tree species, in Nundwe villages largest percentage of respondents (62.5%) preferred *Pinus patula*. Similarly, in Mninga and Igowole villages, more respondents 58.3% and 41.3% respectively had planted *Pinus patula*. While 41.7% of respondents in Igowole and Mninga had planted both *Pinus patula* and eucalypts species, 33.3% of respondents had planted the same in Nundwe village (Table. 19). The choice of trees planted was dependent on a variety of factors ranging from economic potential, the effect on soil and environment, germination efficiency and ability to integrate well with other food crops. The common Eucalyptus tree species planted in the study area included: *Eucalyptus saligna, Eucalyptus grandis, Eucalyptus globules, and Eucalyptus maiden.*

Table 19. Percentage of respondents with their preferred and planted tree species

Tree species planted	The village of the respondents		
	Igowole (n = 24)	Mninga (n = 24)	Nundwe (n = 24)
Pinus patula	41.70%	58.30%	62.50%
Eucalypts spec.	*8.30%*	*0%*	*4.20%*
Pinus patula and *Eucalypts spec.*	41.70%	41.70%	33.30%
Pinus patula and *Acacia mearnsii*	8.30%	0%	0%

4.3.2 Farmers reason for planting preferred tree species

Different reasons were given for tree growers choice to plant a particular tree species (Table 20)

Table 20. Reasons for preferring and planting particular tree species

Village	Tree spp. Preferred	Reason for preference	% responses
Igowole	*Pinus patula*	Good sawn timber prices improve soil and ability to change crops	45.8
		Ability to change crops and improve soil fertility	25
		Good sawn timber prices	16.7
		Ability to change crops	4.2
	Eucalyptus spec.	Fast growth and coppicing ability	37.5
		Multi-products	8.3
		Fast growth	4.2
		Coppicing ability	4.2
	Black wattle (*Acacia mearnsii)*	Fuel and improve soil fertility	8.3
Mninga	*Pinus patula*	Good sawn timber prices improve soil and ability to change crops	58.3
		Ability to change crops and improve soil fertility	16.7
		Improve soil fertility	12.5
		Ability to change crops	12.5
	Eucalyptus spec.	Fast growth and coppicing ability	20.8
		Fast growth	12.5
		Multiple products	4.2
		Coppicing ability	4.2
	Black wattle (*Acacia mearnsii)*	Fuel and improve soil fertility	8.3
Nundwe	*Pinus patula*	Good sawn timber prices improve soil and ability to change crops	45.8
		Ability to change crops and improve soil fertility	37.5
		Improve soil fertility	12.5
		Ability to change crops	4.2
	Eucalyptus spec.	Fast growth and coppicing ability	33.4
		Multiple products	8.3
	Black wattle (*Acacia mearnsii)*	Fuel and improve soil fertility	4.2

Nevertheless, a few farmers managed eucalyptus and black wattle (Acacia mearnsii) species together in Igowole village and their main reasons for planting black wattles (*Acacia mearnsii*) were charcoal production (Figure 24, Annex 4), poles especial for wooden fence construction (hard/resistant to termite) and roofing poles. According to these respondents, it was mentioned that black wattle species was introduced by the government in the 1990's, from Tanganyika Wattles Company Ltd. (TANWAT) in Njombe. The main purpose was for the production of tannin. But other products were construction poles,

firewood, and charcoal for cooking energy. Due to the collapse of the tannin world market, TANWAT did not buy black wattle's bark for tannin production anymore, thus the main use remained construction poles, firewood, and charcoal for cooking energy. However, farmers did not continue to plant black wattles (Acacia mearnsii) because of its highly invasive nature (Sanga, 2016), the tree spread very fast and invaded almost everywhere in the villages within a short time. These features coupled with lack of promised market for tannin, made farmers stop growing and substituted it with eucalyptus species. To date, black wattle is growing anywhere in fallow/unmanaged plots and open public lands also are the main weed tree in woodlots and crop farms. At the moment, farmers are not planting back wattles anymore but only a few people were managing black wattles with some eucalyptus species mainly for charcoal production. On top of that, farmers mentioned that black wattle improves soil, unlike eucalypts.

4.3.3 Farmers woodlots tree species products

The current products from the farmer's woodlots trees based on the studied respondents were timber, slabs, poles, firewood, and charcoal. However, different tree species had different products depending on the demand for use. The detailed proportion of respondent's responses to each product from each planted tree species was shown in the table (Table 21).

Table 21. Farmer's woodlots tree species products in the study area

Village	Tree species	Products	% responses	Total
Igowole	*Pinus patula*	Sawn timber and slabs	41.7	
		Sawn timber, slabs, and firewood	50.0	91.7
	Eucalypt spec	Sawn timber, slabs, firewood, and poles	50.0	
	Pinus patula	Charcoal and firewood	4.2	54.2
Mninga	*Pinus patula*	Sawn timber and slabs	25.0	
		Sawn timber, slabs, and firewood	75.0	100
	Eucalypt spec.	Sawn timber, slabs, firewood, and poles	33.4	33.4
	Acacia mearnsii	Charcoal and firewood	8.3	8.3
Nundwe	*Pinus patula*	Sawn timber and slabs	8.3	
		Sawn timber, slabs, and firewood	91.7	100
	Eucalypt spec.	Sawn timber, slabs, firewood, and poles	41.7	41.7
	Acacia mearnsii	Charcoal and firewood	4.2	4.2

4.3.4 Farmer's woodlot tree species products utilization

Different tree species products in the farmer's woodlots were explored, and the results were shown in the table (Table 22).

Table 22. Distribution of woodlots products and utilization for different tree species

Village	Tree spp.	Products	Sale (%)	Use (%)	Use & sale (%)
Igowole	*Pinus patula*	Sawn timber	91.7	0.0	0.0
		Slabs	0.0	37.5	54.2
		Firewood	0.0	50.0	0.0
	Eucalypt spec.	Sawn timber	50.0	0.0	4.2
		Slabs	0.0	4.2	50.0
		Firewood	0.0	0.0	54.2
		Poles	16.7	0.0	37.5
	Acacia mearnsii	Charcoal	0.0	0.0	4.2
		Firewood	0.0	0.0	4.2
		Poles	0.0	0.0	4.2
Mninga	*Pinus patula*	Sawn timber	95.8	0.0	4.2
		Slabs	0.0	29.2	70.8
		Firewood	0.0	75.0	4.2
	Eucalypt spec.	Sawn timber	41.7	0.0	0.00
		Slabs	4.2	0.0	37.5
		Firewood	0.0	0.0	41.7
		Poles	16.7	0.0	25.0
	Acacia mearnsii	Charcoal	0.0	0.0	8.3
		Firewood	0.0	0.0	8.3
		Poles	0.0	0.0	8.3
Nundwe	*Pinus patula*	Sawn timber	95.8	0.0	4.20
		Slabs	0.0	29.2	70.80
		Firewood	0.0	91.7	0.00
	Eucalypt spec.	Sawn timber	29.2	0.0	12.5
		Slabs	0.0	8.3	33.3
		Firewood	0.0	8.3	33.3
		Poles	0.0	0.0	41.7
	Acacia mearnsii	Charcoal	0.0	0.0	4.2
		Firewood	0.0	0.0	4.2
		Poles	0.0	0.0	4.2

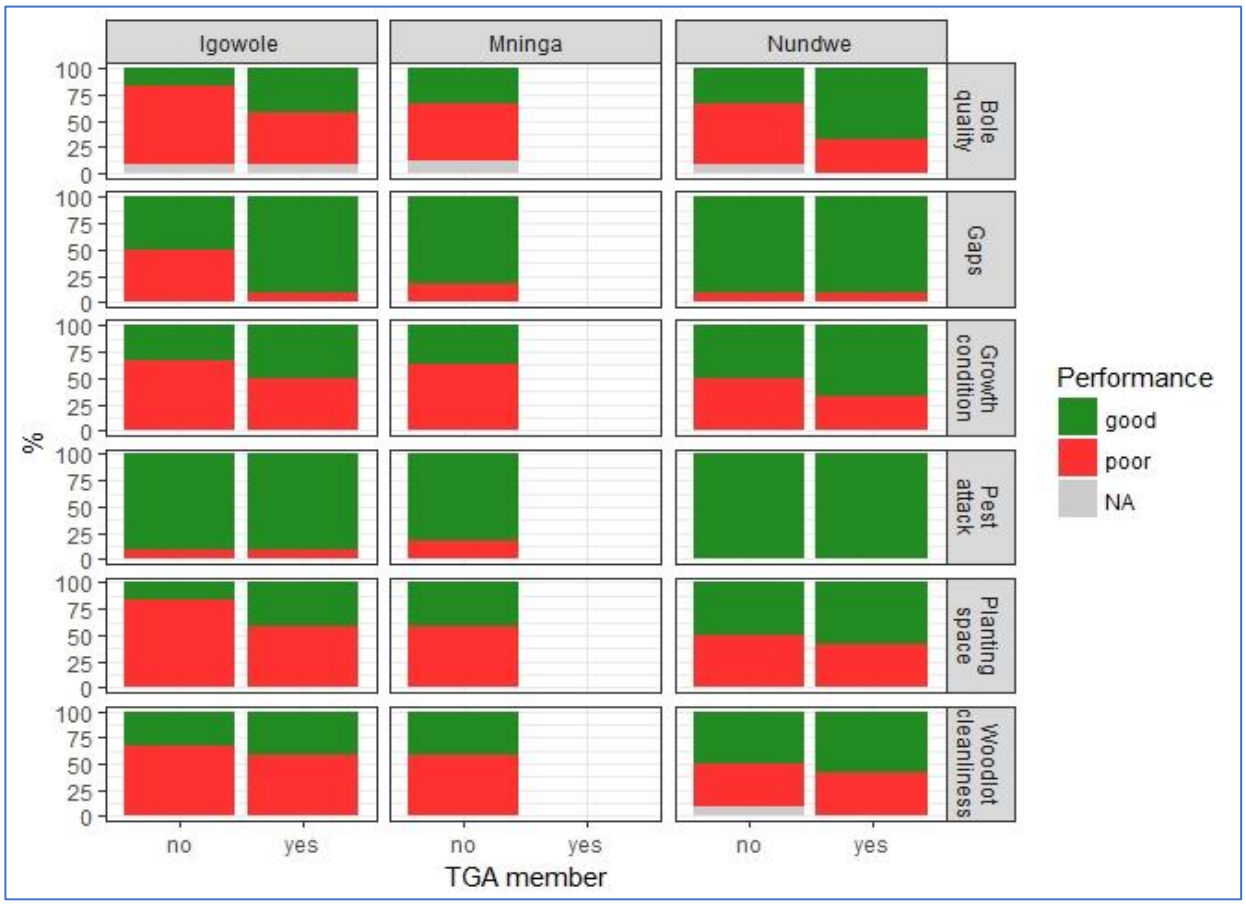
**Use = free use by households the local community in the village*.

4.3.5 Rapid appraisal of farmer's woodlots for performance assessment

The performance of smallholder woodlots can be affected by different factors such as tree growers organization, linkages to support organizations and different forms of incentives. In the study area, tree growers were divided into two categories; the unorganized and organized tree growers (TGAs). Organized and unorganized tree growers had different linkages and networks with support organizations, that might have influenced the performance of their woodlots. Thus, to ascertain this, the performance of the two categories of smallholder's woodlots was assessed using rapid appraisal approach (RA) and the results were presented. To achieve this, six assessment criteria were set and used in RA wood assessment. These criteria included: gaps, woodlot cleanliness, bole quality, planting space, growth condition, and pest attack. All the criteria are well described in (section 3.7.3) of the methodology party of this thesis. From these criteria, value score numbers were assigned based on the Likert scale: 1 = good and acceptable performance, 2 = poor (not good) performance, below an acceptable level.

Nevertheless, to visualize general woodlots performance in different villages, the results were grouped per village. Therefore, a total of 72 woodlots; 24 woodlots for each village were assessed, data analyzed using R-software and results presented in graphs.

The results revealed that in terms of gaps for all three study villages, over 90% of assessed woodlots were performing well, except for unorganized farmers in Igowole village where about 50% of assessed woodlots performed poorly. Also, in terms of pest attack criterion, 100% of the assessed woodlots performed well at Nundwe village and over 90% for Igowole and Mninga had good performance. The little deficits of woodlots performance at Igowole and Mninga villages were attributed to few cases of diseases and monkeys distraction of trees reported in these villages. Regarding bole quality criterion, Nundwe village organized tree growers, had the largest percentage (about 70%) of assessed woodlots performing well, while the majority the assessed woodlots (about 90%) from unorganized tree growers of Igowole performing poorly. While in terms of growth condition, planting space and woodlots cleanliness, a large percentage of woodlots from organized tree growers at Nundwe village were performing well, while a large percentage (over 50%) of the rest of woodlots in all groups and villages (Figure 12).



*NA = Not applicable was used for woodlots with young trees (<5 years), bole quality was not evaluated.

Figure 12. Graphical description of the woodlots performance results per assessment criterion

4.3.6 Age of the assessed woodlots

Age is an important aspect of tree assessment. In this study, woodlots age was important to learn at which rotation age do tree growers harvest woodlots, necessary to compare to previous literature and give recommendations for future management decisions.

The results revealed that majority of assessed woodlots 50%, 45.8% and 66.7% in Igowole, Mninga and Nundwe villages respectively were aged from 5 to 8 years. While, a few percentages of woodlots in all three study villages 12.5%, 16.7% and 4.2% in Igowole, Mninga and Nundwe villages respectively were aged from 9 to 12 years (Figure 13). Tree's growth performance differs at different ages and some quality assessment criteria such as 'bole' could not be determined for trees aged less than 5 years. According to Zahabu et al. (2015), the onset of competition in plantation trees starts at age of 5 years. At this age most, silvicultural treatments for stand improvement such as pruning and thinning start. Thus, at age less than 5 years the trees are still small in size, small boles, less competition and fewer impacts from human management treatments on trees.

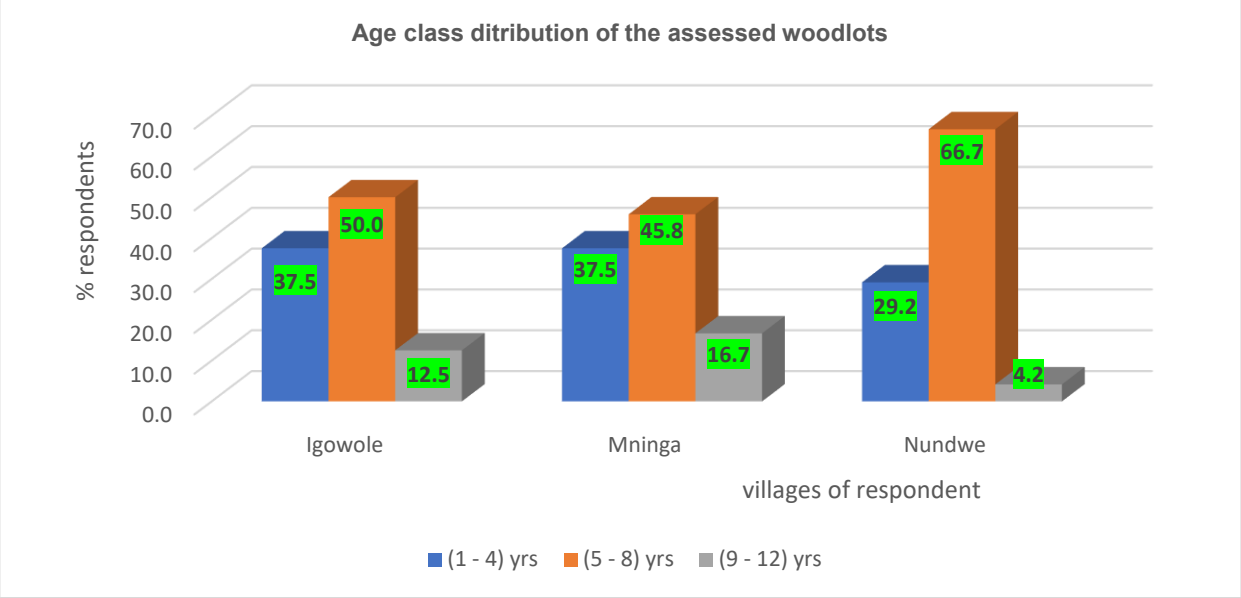


Figure 13. Age distribution of assessed woodlots in the study areas

4.3.7 Tree growers satisfaction in relation to their woodlots performance

Regarding tree growers satisfaction on the performance of their woodlots, in Nundwe village all respondents were happy and satisfied. While 85.5% and 79.2% were happy and satisfied in Igowole and Mninga villages respectively. (Figure 14).

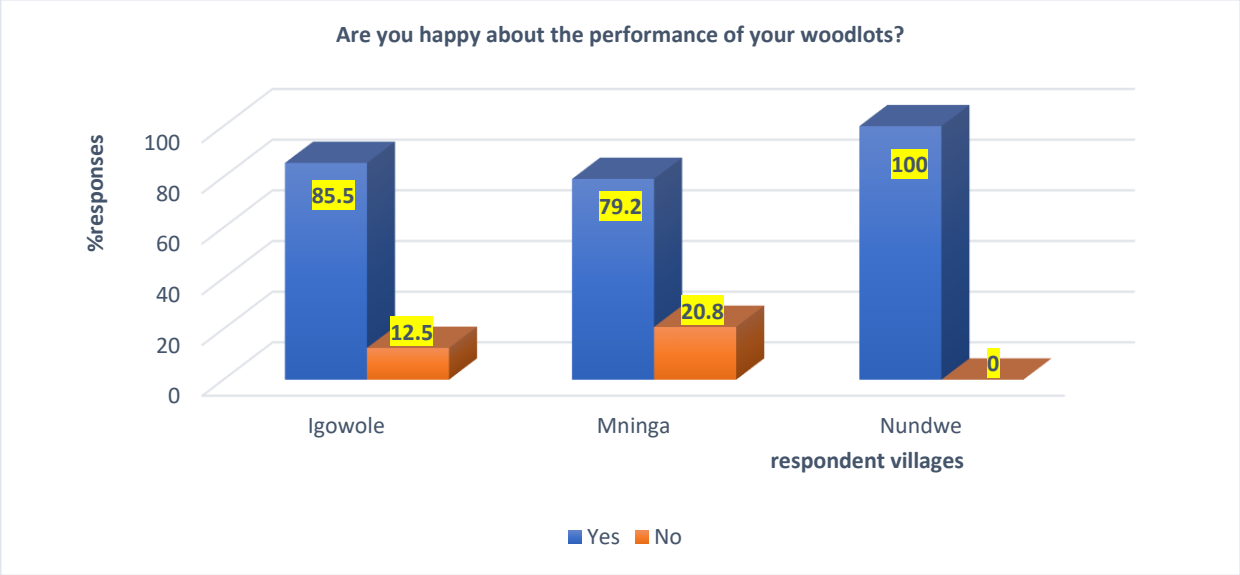


Figure 14. Satisfaction of tree growers with regards to their woodlots performance

Some reasons for satisfaction about tree performance for some tree growers at Igowole and Mninga (12.5% and 20.8 %) are: lack of confidence for seedlings quality as majority purchased from nursery operator farmers, missing confidence on the way they were planting and managing trees as well as missing technical knowledge such as on stand improvement to shorten rotation age, adequate age and tree size for harvesting and bole quality enhancement.

4.3.8 Relationship between woodlots performance and woodlot size

A relationship between woodlot performance and woodlot was determined using a Wilcoxon test (P = 0.05), and the results revealed no significant difference in all three villages (Figure 15).

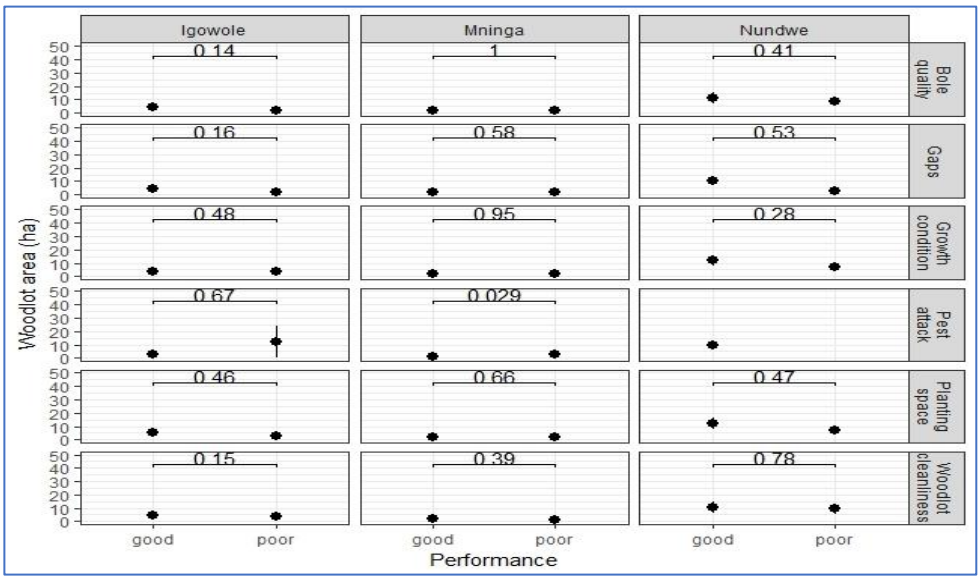


Figure 15. The relationship between woodlots size and woodlots performance

4.3.9 Relationship between woodlot size and farmer category (organized or unorganized)

A Wilcoxon test (P = 0.05), revealed no significant difference (P = 0.58) in woodlots size between organized and unorganized farmers in Igowole. While in Nundwe village, similar test (P = 0.05) revealed significant difference (P = 0.037). Meaning that organized farmers had large woodlot size than unorganized farmers at Nundwe village. And, no test was done for Mninga village, as all farmers were unorganized only (Figure 16).

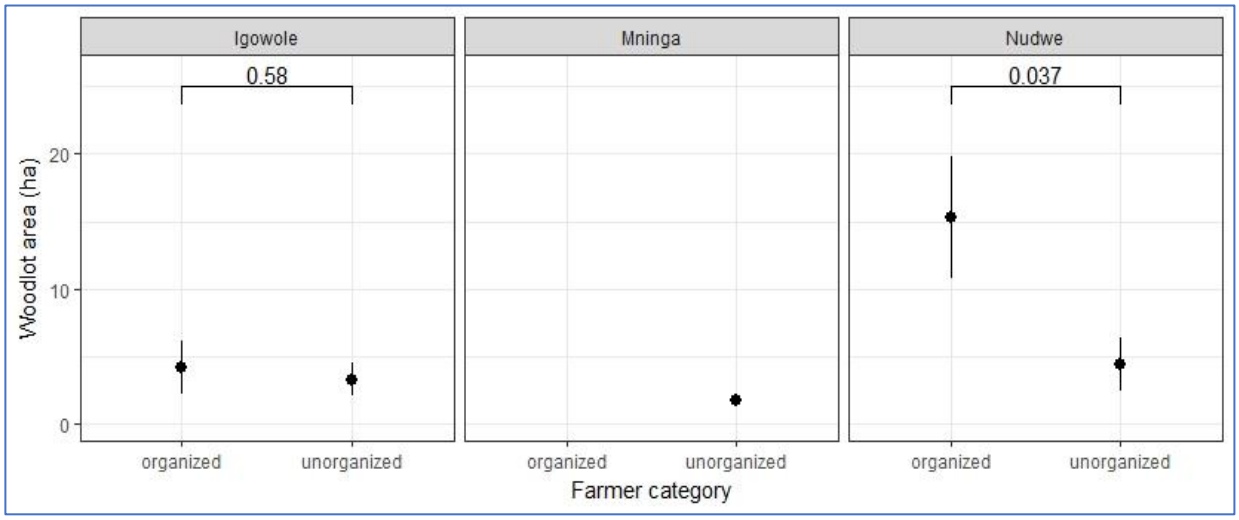


Figure 16. The relationship between woodlot size and farmer category (organized or unorganized)

4.4 Tree grower's organizations, support organizations, and linkages in the study villages

4.4.1 Tree grower's organizations in the study area

Tree growers in the study area were divided into two categories: organized and unorganized tree growers. While organized tree growers were those who joined and worked in tree grower associations (TGA) including UWAMINU TGA at Nundwe and ICFG TGA at Igowole villages. When asked the reasons for organizing into TGA, both members and leaders gave different reasons as follows: (1) To attract support from organizations of which most of them showed the interest of supporting organized tree growers. That means organizations of tree growers into TGAs was triggered by support organizations. For example, in the private forestry program (PFP) document (2014 – 2017), result area 2 "smallholder plantation forestry development" included promotion of tree grower associations (TGAs), while other activities were village land use planning, woodlots establishment and management and promotion of income generating activities (PFP, 2015:26). (2) To share knowledge and cost on tree seedlings production. For example, UWAMINU TGA at Nundwe village received tree seeds and planting material supports from PFP, FDT, and TaFF. The supported seeds were raised together in a common tree nursery in which all TGA members had a portion of seedbed to manage sharing knowledge and experiences as well as saving cost by deploying their manpower. Also, ICFG TGA at Igowole received improved tree seeds and planting materials from PFP.

Those seeds were raised by nursery operator farmers who were members of the TGA and distributed freely among TGA members. This reduced the cost for raising the seedlings among other tree growers on one hand, but the cost was not distributed to all tree growers on another hand. In addition, knowledge and experience sharing among tree growers were missing for ICFG TGA as the seedlings were raised by only a few nursery operators in the TGA. (3) To influence making and adoption of fire management by-laws in the village. TGA is recognized as a committee and their leaders have representation in the village council meetings. This gave them the opportunity to contribute their opinions and participate in by-laws proposal in the villages. By this reason, villages with TGAs could have more strong fire-related by-laws and enforcement than villages without TGAs. (4) To ensure access to market information and strengthen bargaining power over woodlots products including standing trees, timber and poles. The TGA members said this objective was not succeeding because the majority of the tree growers were not members of TGAs in the villages, thus could sell their products individually at the price they agreed with the buyers. That means TGAs lost bargaining power and a strong voice on a fixed-price setting based on real existing timber market.

4.4.2 Objectives, expectations and mandate of support organizations

A question to both tree growers and support organizations about what were objectives, expectations, and mandate for supporting tree growers, was asked to each actor during the interview. And, their responses were recorded and summarized in tabular form (Table 23).

Table 23. Objectives, expectations, and mandates of various support organizations to woodlot farmers

No	Support organization	Type of support offered	Objectives	Expectation	Mandate
1	Private Forestry Program (PFP)	i. **Training** a) Nursery tree seedlings production, farm preparation, tree planting and management, Importance of tree growing for household income	- Promote smallholders to plant and manage trees - Disseminate tree planting and management knowledge	- Promote tree planting among smallholders	- Monitoring on farmers adoption rates of new innovations. - Will continue to carry out studies/surveys to assess woodlots performance - No signed and binding agreement on compliance with the services provided. - However, the earlier and better-adopting tree growers/TGAs
		b) Establishment of tree grower associations (TGAs) and draft TGA administration manual **Procedures** - Awareness raising to the village councils and general meeting on the meaning and importance of TGA. - Voluntary registration of interested members, normally the residents in the village engaged in tree growing	- To encourage tree growers to join TGAs - To make easy access to tree growers by communication and organized meetings - To reduce bureaucracy in meeting tree growers - To empower tree growers in price negotiation, market	- To keep farmers more organized for efficient and effective use of internal and external resources	

		- Holding the first founding meeting (election of leaders – chairperson, secretary, treasurer) - Drafting of a constitution in which norms and rules are set - Registration at the district community development office	contacts, and technology improvement - To increase the benefits of collective action - To simplify monitoring - To set similar TGAs operation standards in all villages (Issued TGA administration manual in 2017)		attracted more support.
		c) Establish village saving organization (VSO) - credit saving and borrowing (revolving funds - groups)	- To reduce premature harvesting/extend rotation age of trees among tree growers by availing funds for borrowing with low interests in case of quick need for cash money	- Improve woodlots product quality, market, and price	
		ii. Supply of free improved seeds and planting materials	- To promote the use of improved seeds among smallholder tree growers - To enhance tree growth performance and woodlot quality	- Improve woodlot tree performance	
2	Forest Development Trust (FDT)	**i. Training** Nursery tree seedlings production, farm preparation, tree planting and management, Importance of tree growing for household income	- Disseminate tree planting knowledge and encourage tree planting among smallholders	- Promote tree planting among smallholders	- To monitor farmers adoption rates of new innovations. - To carry out studies/surveys to assess woodlots performance
		ii. Supply of improved seeds at a discounted price and free planting materials	- To promote the use of improved seeds among smallholder tree growers - To link farmers with improved seeds supplier company - To enhance tree growth performance and woodlot quality	- Improve woodlot tree performance	
3	Tanzania Forest Fund (TaFF)	Funding	- To support forest conservation initiatives of smallholders residing around forest areas	Reduction of dependence by illegal harvesting of government natural and planted forests	- A funding application is voluntary, by stipulating down what to be implemented based

			- To support tree planting and management initiatives (in terms of skills, quality seeds, and planting materials) among smallholders to improve their income (livelihood) and restore degraded areas.	To increase the supply of wood materials from farmers own woodlots. To improve smallholders forest-based income from their own woodlots	of TaFF provided guideline. - The agreement is signed indicating responsibilities and accountability over the granted funds. In case of failure to comply; warning, refund, prosecution and funding withdrawal is included on the agreement. - Funds were disbursed in three installments and each installment is reported on how the funds were used and inspected by the fund auditors.
4	Sao Hill/Tanzania Forest Services (TFS)	**i. Public education, mainly on fire protection issues**	Equip farmers with the dangers of fire on planted forests, fire protection, and fighting skills and promote tree planting among themselves	Reduce forest fires which mostly originated farmers. When they protect their trees/woodlots Sao Hill forest get protected too.	Extension services
		ii. Supply of free improved seedlings	Promote tree planting among smallholders	Farmers plant trees and protect them from fire	Improve public relation
5	Mufindi District Council	a) Nursery tree seedlings production, farm preparation, tree planting and management, Importance of tree growing for household income	Disseminate tree planting knowledge and encourage tree planting among smallholders	Farmers have necessary skills to raise seedlings and manage woodlots	Farmers produce wood materials, sale and improve income
6	Tree Grower Associations (TGAs)	Promotion of farmer organization	Encourage woodlots farmers collective action	Woodlot farmers have a strong voice	Member registration and annual fees, constitutional abidance (rule and regulations), voluntary entry and
		Training	Promote technical woodlots establishment and management	Improve woodlot tree performance	
		Seeds/seedlings and planting materials	Promote the use of quality seeds/seedlings		

					exit based on constitutional rules.
7	Nursery operator (local farmers)	Tree seedlings	Avail tree seedlings for planting among smallholder tree growers (Sold cheaply, the seedlings were raised using mainly locally collected seeds)	Promote tree planting among smallholders	None

4.4.3 Organizations supporting tree growers in the study villages

Regarding organizations and individuals supporting woodlots farmers in growing trees in the study area, the results revealed that organized farmers received different supports from support organizations through their TGAs. Supports included: free training, quality seeds and planting materials, funding, communication, and information sharing. For example, at Igowole village, organized farmers of community and family group (ICFG) TGA received Pine (2kg), Eucalypt (1Kg) seeds and planting material from Private Forestry Program (PFP) in 2016 that they raised and distributed for planting in 2017 planting season. PFP acknowledged that they bought seeds from Tanzania Tree Seed Agency (TTSA) – Iringa, a country's certified tree seed supplier. While at Nundwe village, the *Umoja wa Wakulima wa Miti* Nundwe (UWAMINU) TGA, received seedlings from Forestry Development Trust (FDT) organization in 2016 that they raised in common nursery and planted in 2017 season. Also, UWAMINU TGA received funding from Tanzania Forest Fund (TaFF) in 2012 and 2016 to facilitated bought seeds and planting materials from TTSA – Iringa which they raised 132,500 seedlings in 2013 and 240,000 seedlings in 2017 in a common nursery and distributed among members to plant in 2013 and 2017 seasons respectively. Since 2012 to 2018 UWAMINU TGA members were able to raise seedlings in their common tree nursery using quality seedlings purchased from a certified source (TTSA).

On the other hand, the majority of unorganized farmers received supports mainly seedlings from nursery operator farmers in their villages. For example, 45.8%, 79.2% and 45.8% of woodlots farmers at Igowole, Mninga and Nundwe villages respectively had received tree seedlings and some information from fellow farmers (nursery operators) who raised and sold tree seedlings in the village. While 16.7% of the study respondents at Mninga village had received seedlings from Mufindi district and Sao Hill management, 4.2% in Igowole and Nundwe had received free training and seedlings from Mufindi district (Table 24). During actor interview with Mufindi district forest officer said that they had a Danish-funded program (HIMA) between 1998 to 2003 reported also in Singunda (2010), the program which was implemented under Mufindi district management structure to support farm forestry including the study villages. In addition, there was no TGA in Mninga village, and very little proportion of farmers had been supported by exogenous organizations.

Table 24. Support organizations and farmers proportions in each category

The village of the respondent	Type of support organization	Percent (n = 24)
Igowole	Farmer	45.8
	Tree Grower Association (TGA)	50.0
	Mufindi DC	4.2
Mninga	Farmer	79.2
	Forest Development Trust (FDT)	4.2
	Mufindi DC and Sao Hill	16.7
Nundwe	Tree Grower Association (TGA)	50.0
	Farmer	45.8
	Sao Hill	4.2

Pertaining to time since when tree growers received last support, the results indicated that, in Igowole village more of the respondents (58.3%) received that last support between 2014 and 2016, while Nundwe village more respondents (45.8%) had received last support between 2017 and 2018 and for Mninga village largest percentage (75%) of respondents received last support in 2017 and 2018. Inferring that, most tree growers had planted trees recently in Mninga village and most of them received mainly seedlings by buying from tree nursery operators in the village (Table 25).

Table 25. The last time when woodlot farmer received support

The village of the respondent	Lastly supported	Percent (n = 24)
Igowole	2011 - 2013	16.7
	2014 - 2016	58.3
	2017 - 2018	25.0
Mninga	2014 - 2016	25.0
	2017 - 2018	75.0
Nundwe	2011 - 2013	12.5
	2014 - 2016	41.7
	2017 - 2018	45.8

4.4.4 Woodlots actor's networks and linkages

To answer this research question, the studied woodlot farmer's social networks were analyzed and their relationships both among farmers themselves and supporting organizations for each of the three villages were presented.

4.4.4.1 Woodlot actor's networks at Igowole village

A total of 31 actors in network tiers were identified and interviewed in Igowole village (Figure 17). Such actors included: the 24 tree growers (12 unorganized and 12 organized tree growers), nursery operator farmers, Mufindi district council and Private Forestry Program (PFP). Different network tiers established were due to different needs for resources necessary for woodlots farmers. The resources included: training, seeds and/or seedlings supply, information sharing and communication. All the organized farmers received free quality seedlings and training from the TGA. The seeds and training were supported by PFP to the TGA. Unorganized farmers purchased seedlings from nursery operators in the villages. In addition, a few

organized farmers purchased additional seeds from nursery operators. While farmers who were members of the TGA paid nothing in return but only a fixed membership fees (registration fee USD 8.7 for new members, membership fees USD 0.4/month or USD 4.8/year) while unorganized farmers paid cash money

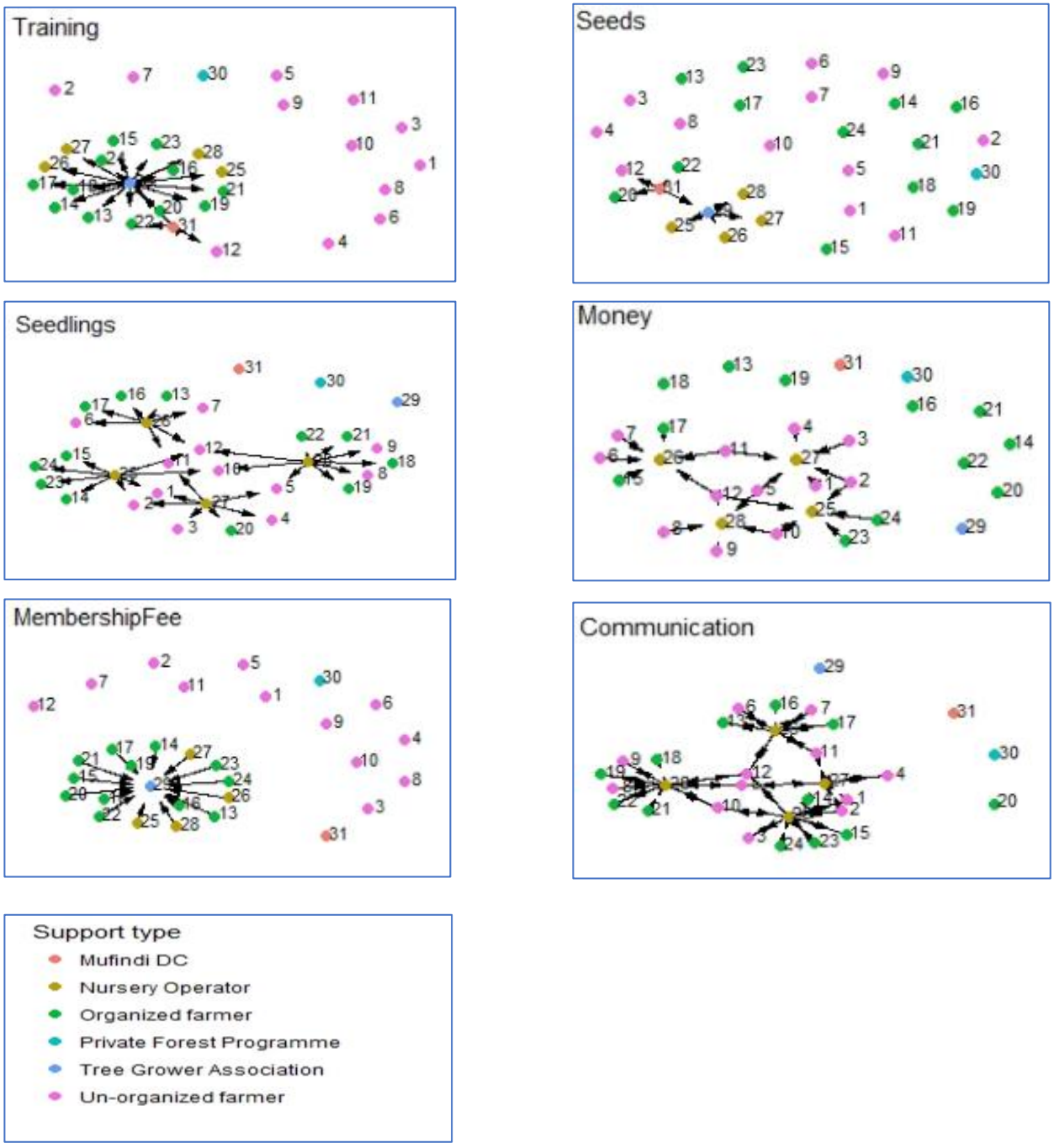


Figure 17. Woodlots actor's network at Igowole village

(USD 0.04/seedling) to nursery operator farmers who raised and sold seedlings. On average a farmer required about 1,500 seedlings to plant one hectare. Moreover, good communication and information

sharing network was observed among both organized and unorganized farmers, nursery operators as well as a TGA.

Actor 24 was a TGA, with higher outdegree centrality linking organized tree growers to free training and improved seedlings provided to it by support organizations. Also, actors 25, 26, 27 and 28 showed were nursery operator farmers who raised seedlings for the organized farmers in a TGA. ICFG TGA did not have a common tree nursery such that seeds supported by the organization were raised by nursery operator farmers in the request of the TGA on an agreement to get seedling and exemption to the payment of annual membership fees. Most nursery operators were those tree growers who have frequently received training through different support programs in the area. For example, HIMA program to support smallholder tree planting which was implemented in the southern highlands between 1998 and 2002. Now, these nursery operators are actively engaged in the current support programs and have equally received training with other tree growers in ICFG TGA. On one hand, it is good that nursery operators were able to raise seedlings for the TGA in Igowole village. But on the other hand, the fact that no common tree nursery for all ICFG TGA members to engage collectively in seedlings production activities limits the spread of knowledge to other tree growers.

Again, based on the network data, the following were observed for Igowole village: number of isolates; 12 for training because only TGA members received training; 3 for seedlings because all farmers were linked for seed resource to relevant potential nodes; 2 for information sharing meaning that information ties were connected to most actors; 22 for seeds because seeds were supplied by support organizations mainly to TGA, then the TGA raised seedlings through the nursery operators, 11 for money, that was for money paid by the non TGA members for seedlings to nursery operators and 4 for communication, majority of the actors were communicating in the network. Reciprocity was 100% for communication, meaning that all actors were communicating in the network. (Table 26).

Table 26. Woodlots actor's network at Igowole village (n = 31)

Network	Nodes	Isolates	Network density	Reciprocity	Outdegree centrality	In-degree centrality	Transitivity	Weak components	Strong components
Training	31	12	0.02	0	0.53	0.05	0.12	13	31
Seedlings	31	3	0.03	0	0.28	0.07	1	4	31
Information	31	2	0.04	0.06	0.27	0.07	0.18	4	30
Seeds	31	22	0.01	0	0.13	0.03	0	23	31
Money	31	11	0.02	0	0.08	0.18	1	12	31
Communication	31	4	0.07	1	0.24	0.24	0	5	5
Membership Fee	31	14	0.02	0	0.02	0.53	1	15	31

4.4.4.2 Woodlot actor's networks at Mninga village

All sampled 24 woodlots farmers at Mninga villages were unorganized. The results reveal that only a fifth of tree growers (20.8%) had received training. This training was provided by FDT in 2016, and HIMA program between 1998 and 2002. FDT had established contacts with the village government through the village executive officer (VEO) to get the target motivated farmers. Due transfer of VEO, the new VEO could not find any documentation on whom received support and those who received could not remember all others. While most of the tree growers had network ties to tree nursery operator farmers being mainly connected for tree seedlings purchases (costing about USD 0.04/seedling). Currently, most support organizations preferred to support organized farmers in TGAs. The fact that Mninga village had organized farmers, there was no active support from any organization, thus making all tree growers buy seedlings entirely from nursery operator farmers.

Only a few ties link a few farmers to support organizations that included: Forest Development Trust (FDT), Mufindi DC, Sao Hill and 5 nursery operators making a total of 32 actors in networks. In fact, 8.3% tree growers had received seedlings from Sao Hill organization. Communication network was well established with nursery operators mainly for feedback and bringing new customers for seedlings (Figure 18).

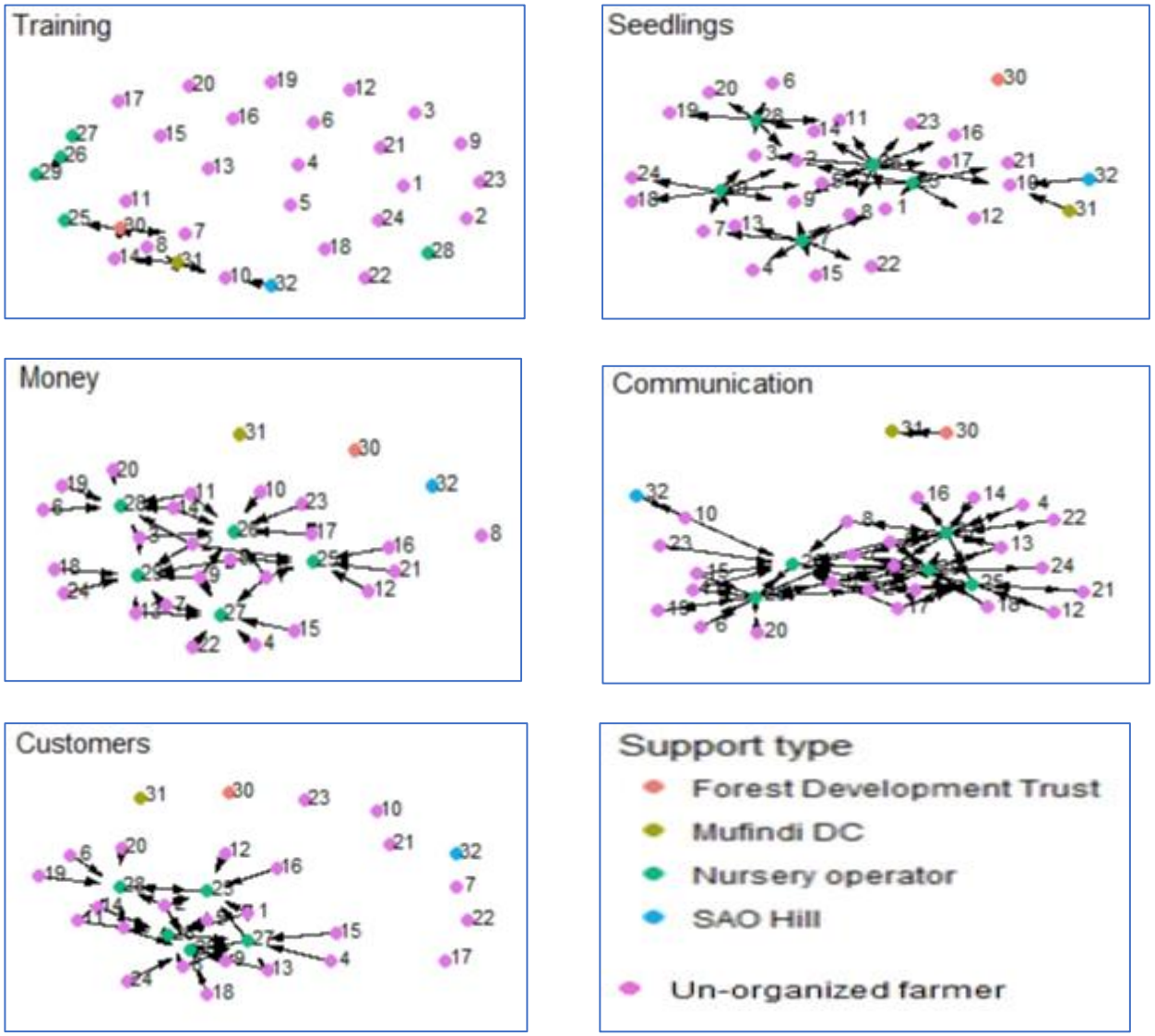


Figure 18. Woodlots actor's network at Mninga village

On the other hand, in terms of training, most of the actors were isolated from the training, the majority of actors highly connected for seedlings and communication. A large number of isolates from training was due to the fact that farmers in Mninga villages were not organized. During actor interview, both supported tree growers and FDT acknowledged that the village support approach failed in Mninga village. The main reason was that Mninga village did not have free space nearby the village to offer to establish a common demonstration plot. As the result, FDT selected some model farmers with land around the village where all other farmers had gathered and work together. The activities included: raise seedlings on nurseries, planting, pruning, and other tree management activities. This approached was later criticized by most of the tree growers because they spent their time working on some one's private farm while their farms remained unattended.

Nevertheless, indegree centrality seems higher 26% for customers and money due to customers and money paid when farmers bought seedlings from nursery operators. While 31% of in-degree centrality was for communication mainly from the farmers to nursery operators. Reciprocity was observed to be higher in terms of communication (83%), and 15% on customers. That was because most woodlot farmers ensured contact with tree nursery operators. In addition, woodlots farmers who bought seedlings from nursery operators were able to attract other customers in return. Only a little outdegree centrality (15%) training due to few actor farmers who received training, 24% communication mainly from nursery operators to farmers and 32% for farmers who received seedlings. Further details can be viewed on the table below (Table 27).

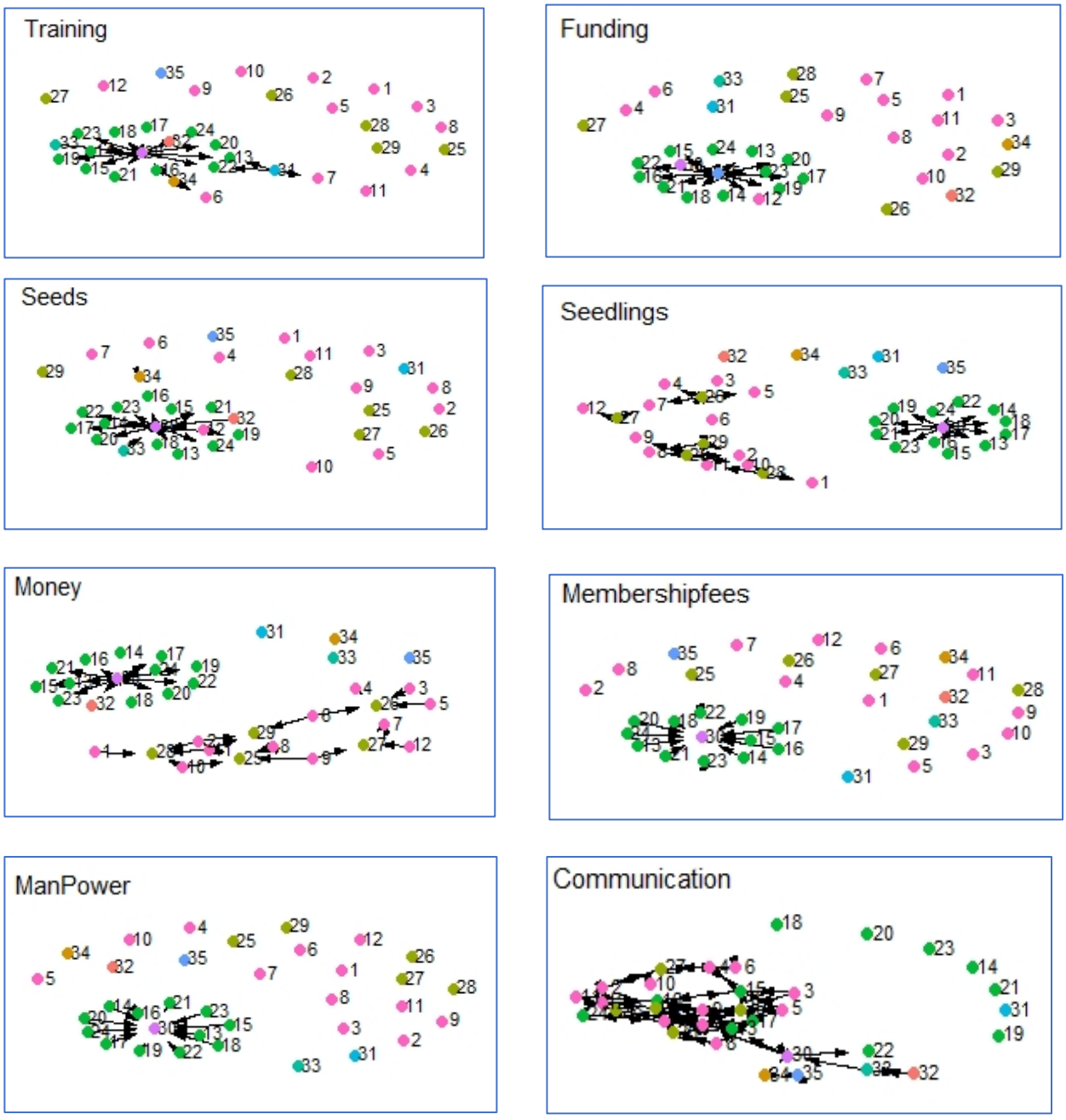
Table 27. Woodlots actor's network at Mninga village (n = 32)

Network	Nodes	Isolates	Network density	Reciprocity	Outdegree centrality	In-degree centrality	Transitivity	Weak components	Strong components
Training	32	20	0.01	0	0.15	0.05	1	22	32
Seedlings	32	1	0.04	0	0.32	0.06	1	2	32
Customers	32	9	0.04	0.15	0.06	0.26	0.32	10	29
Money	32	4	0.04	0	0.06	0.26	1	5	32
Communication	32	0	0.09	0.83	0.24	0.31	0.12	2	4

4.4.4.3 Woodlot actor's networks at Nundwe village

In total, 35 actors were identified engaged in woodlots development at Nundwe village including: 24 sampled households (12 organized and 12 unorganized tree growers), UWAMINU[4] TGA, Forest Development Trust (FDT), Tanzania Forest Fund (TaFF), Private Forestry Program (PFP), Sao Hill and Mufindi district (see details in Figure19). It was revealed that all 12 organized farmers received free quality seeds to raise seedlings, funds to support seedling transport to planting site from UWAMINU[5] TGA, while 12 unorganized farmers were buying seedlings in cash money from 4 nursery operators in the village. Nevertheless, UWAMINU TGA had received funding twice in 2012 (USD 2,261) and 2017 (USD 6,186) from Tanzania Forest Fund (TaFF) to implement tree planting. Such funds facilitated training of TGA members, purchase of quality seeds and planting materials for nursery seed production. PFP supported free training, seeds and planting materials for nursery management to the TGA. Again, Sao Hill and Mufindi DC had supported a few unorganized farmers free training on fire management and seedlings. Tree growers, TGAs, nursery operators and their linked organizations exhibit a good network of communication in both directions indicating a good flow of information between actors. It was observed that Nundwe village had the highest number of actors and supporting organizations in its networks.

[4] *Umoja wa Wakulima wa Miti* Nundwe = *kiswahili* word that translates, Nundwe Tree Growers Union.
[5] *Umoja wa Wakulima wa Miti* Nundwe = *kiswahili* word that translates, Nundwe Tree Growers Union.



Support type

- Forest Development Trust
- Mufindi DC
- Nursery operator
- Organized farmer
- Private Fofest Program
- SAO Hill
- Tanzania Forest Fund
- Tree Grower Association
- Un-organized farmer

Figure 19. Woodlots actor's network at Nundwe village

In this village, the number of isolates seems fewer in seedlings (5), communication (7) and money (4) that was because the majority of farmers were actively connected for seedlings resources, communication was taking place to support organization, then down across both organized and unorganized farmers. Unorganized farmers buy seedlings (USD 0.04/seedling) from nursery operators, while organized farmers received money from their TGA making all farmers connected and only a few higher-level actors isolated in a network. Interestingly, reciprocity was the highest 96% for communication revealing effective two-way communication among network actors. Outdegree centrality was higher in training (35%), funding (41%), seedlings (33%), money (36%) and seeds (38). Altogether, are explained by connection to central tie in the TGA in which 12 farmers actors were fully connected and obtained most of the woodlot resources. While indegree centrality was higher only in membership fees and manpower (35%) and communication (13), while in other networks was less than 10% (Table 28). UWAMINU TGA had a collectively managed tree nursery where every member of the TGA has a portion to manage seedlings production. That means every member contributed free manpower to the TGA tree nursery, that offered free seedlings and transport money to planting area (about USD 10 for each member) on return. Similarly, TGA members paid the registration fee (USD 8.7), membership fees (USD 0.4/month or USD 4.8/year) as a qualification and responsibility of active membership to get all necessary resources that a TGA offered. UWAMINU TGA (number 30 in figure 19) had a common tree nursery collectively managed by the members. Each TGA member had a portion of seedbeds to take care and contributed a free manpower to nursery management.

Table 28. Woodlots actor's network at Nundwe village (n = 35)

Network	Nodes	Isolates	Network density	Reciprocity	Outdegree centrality	In-degree centrality	Transitivity	Weak components	Strong components
Training	35	16	0.02	0	0.35	0.07	0.03	17	35
Funding	35	20	0.01	0	0.41	0.02	1	21	35
Seedlings	35	5	0.03	0	0.33	0.06	1	7	35
Communication	35	7	0.08	0.96	0.1	0.13	0.05	8	11
Money	35	4	0.03	0	0.36	0.12	1	6	35
Membership fees	35	22	0.01	0	0.02	0.35	1	23	35
Man-power	35	22	0.01	0	0.02	0.35	1	23	35
Seeds	35	18	0.01	0	0.38	0.05	0	19	35

4.5 The impact of tree grower's organizations (TGAs) on woodlots performance

A logistic regression model was used to assess the relationship between dependent variables (TGA membership, household size) and independent variables (Gaps, Growth condition, planting space, Bole quality, and Woodlots cleanliness). The analysis parameters of estimation included: standard error (Std Error), t-value, significance level (p-value) as well as minimums and maximum values. However, the choice of a parameter to be used to interpret model results differs across disciplines (Dytham, 2011). But it also

depends on the researcher preference. In the present study, the level of significance was used to interpret the model results.

Thus, logistic regression analysis (generalized) model was run to see if there were significant differences (P = 0.05) in woodlots performance factors (gaps, growth condition, woodlots cleanliness, bole quality, and planting space) with variables of TGA membership and household size. The results revealed that based on gaps criterion, the variation was highly significant (P = 0.00216) among TGA members, while the difference was not significant with household size (P = 0.91810). Since gaps in woodlots measured survivorships, which means better performance among organized tree growers was contributed by knowledge about timely, enrichment planting and right planting. Also, based on growth conditions both TGA membership and household size showed significant and highly significant differences (P = 0.04478 and P = 0.00279) respectively. As such, growth condition determined the growth of trees in relation to competition by trees themselves or weed trees and fire histories. Trees planted in small planting spaces suffered competition, similarly trees with uncleared weed trees (for example; *Acacia mearnsii*) also, due to lack of thinning practices. In addition, previously fire-damaged trees experience a very slow growth rate. The influence of household size on growth condition, was because household size determined the availability of family labor to carry out management activities such as pruning, weeding and fire protection to ensure good growth. Moreover, based on planting space criterion, both TGA membership and household size had significant differences (P = 0.0199 and P = 0.02013). Nevertheless, based on bole quality and woodlots cleanliness both TGA membership and household sizes did not have significant differences (see Table 29 for details).

Table 29. Logistic regression of woodlots performance variables

No	Explanatory variable	Std. Error	t – value	P-value	Min	Max
1	**Gaps**					
	TGA member (yes)	0.117757	-3.191	0.00216**		
	Household size	0.022805	0.103	0.9181	-0.4837	0.93927
2	**Growth condition**					
	TGA member (yes)	0.15811	-2.045	0.04478*		
	Household size	0.03062	3.105	0.00279**	-1.1128	1.00528
3	**Planting space**					
	TGA member (yes)	0.15339	-0.969	0.02013*		
	Household size	0.0297	2.386	0.0199*	-1.0068	0.9806
4	**Bole quality**					
	TGA member (yes)	0.15945	-1.26	0.2125		
	Household size	0.0321	0.893	0.3752	-0.8739	1.1548
5	**Woodlot cleanliness**					
	TGA member (yes)	0.17066	-1.257	0.213		
	Household size	0.0327	1.715	0.091	-1.0783	1.2984
	Significance codes	**0 '***',	**0.001'**',	**0.01'*',	**0.05'.',	**0.1 '**

This could be due to two major reasons, firstly; bole quality is determined by other factors such as correct pruning practices, straightness as well as the size of the tree bole. And secondly; due to snowball sampling design which captured only tree grower farmers who have relations, TGA member farmers, and support

organization. Thus, tree growers not linked to this networks were not included in the sample. The significant differences in woodlots performance among TGA members could be, on one hand, due to better network resources such as knowledge on tree planting and management among organized tree growers, quality seedlings, funding, the power of collective action that they had and support they received from organizations through their TGAs.

CHAPTER FIVE

5. DISCUSSION

5.1 Characteristics of respondents

5.1.1 Selection of the study respondents, sampling and limitations

The exact sampling frame of the tree grower households in the study villages was not known, because of the lack of documentation of tree grower's information and registry in the village offices. But a recent study by the wood cluster project estimated that about 85% (561) of households in Nundwe and 90% of households in Igowole (2,046) and Mninga (1,051) villages were tree growers (Wood Cluster, 2018). Out of which, 29 households in Igowole and 30 households in Nundwe were organized tree growers in TGAs.

This study adopted a case study approach. The case study research method is an empirical inquiry that investigates a contemporary phenomenon within its real-life context when the boundaries between phenomenon and context are not clearly evident, and in which multiple sources of evidence are used (Yin, 1984:23). It enables a researcher to closely examine the data within a specific context. In most cases, a case study method selects a small geographical area or a very limited number of individuals as the subjects of study (Yin, 2006, 1984). In addition, the case study method provides a practical solution when a big sample population is difficult to obtain (Yin, 2006). Not only the study population was large, but also organized tree growers could not be reached all and RA woodlots assessment task would not be accomplished in a robust sample size for this study.

Thus, 24 tree grower households were purposively selected in each village by snowball sampling which traced the network of related tree growers, TGAs and associated support organizations. This sample was not large enough and representative for all tree growers in the study villages. The sample proportions were 1.2%, 2.3% and 4.8% of all tree growers in Igowole, Mninga, and Nundwe respectively. Small sample size and purposive selection of respondents both limit the generality of findings from the samples to mean the whole tree growers (Yin, 2006; Claridge, 2004; Griffiths et al., 1993; Berg, 1988). Yin (2006), argues that these problems associated with the case study method can be reduced by combining many methods of data collection and/or generation of larger samples. As such, in the present study, multiple methods were used to collect data including researcher direct observation, physical measurements, woodlots performance assessment by rapid appraisal (RA), household and organizational/institutional/key informant interviews, focused group discussions and literature reviews supplemented secondary data. Consequently, this makes the results more profound and valid for studied respondents. However, Yin (1994), argued that the generality of results from case studies rely on theory rather than on the representativeness of the study populations.

On the other hand, to compare the woodlots performance between the organized and unorganized tree growers, 12 households out of the 24 sampled in each village were from organized (TGAs) for Igowole and Nundwe villages respectively. The sample of 12 households was large enough (41.3%) of 29 and 40% of 30 members of TGAs in Igowole and Nundwe villages respectively. According to Aberdeen (2013) and Yin (2006), a minimum sample of 10% is enough to be representative for the study population. That means the samples for TGAs were large enough thus representative, and analytical generalization of the findings was possible on TGA members for both Igowole (ICFG TGA) and Nundwe (UWAMINU TGA).

5.1.2 Household landholding and land for woodlots

The land is the main requirement for tree planting and managing trees in woodlots. More of the study respondents in all the three villages owned land between (<1 – 3) ha. A similar finding was presented by a survey study by Singunda (2010) in the study area, that majority of the farmers in Mufindi district, owned between (0.4 – 4) ha of land. However, descriptive statistics indicated that average land holding for these woodlot farmers was 6.02 ha, 2.8 ha and 15.9 ha for Igowole, Mninga and Nundwe villages, respectively. That means tree growers had land available for woodlots establishment, although differed between villages. But because of the increasing number of people investing in woodlots, a shift in land acquisition procedures from largely inheritance (Singunda, 2010; Nkwera, 2010) to buying has emerged. To avoid land scarcity for woodlots in future, agroforestry practice that combines both crops and forestry need to be promoted.

On the other hand, led by Nundwe, all villages are characterized by larger average landholding. These averages are higher than reported average household land holding which was about 2.4 ha (Wood Cluster, 2018; FDT, 2015) in Mufindi district. There are various reasons to account for these differences. Firstly; Woodlots farmers are normally characterized by higher land holdings than the non-woodlot farmers (Adane, 2016; Gregorio & Herbohn, 2010; Nsiah & Pretzsch, 2010, Singunda, 2010). Secondly, higher averages in the present study findings could be affected by sampling design and sample size, which involved snowball sampling, more likely to have captured only the active woodlots farmers who are normally characterized by higher land holdings. Nundwe village had the highest mean woodlot size of 9.86 ha, followed by Igowole 3.7 ha and lastly Mninga with 1.7 ha. Which means woodlot size is directly proportional to the household landholding. Other reasons for highest both mean land holding and woodlot sizes in Nundwe village are that Nundwe was previously not easily accessible by roads almost a year around and lack of social services such as health centers and electricity power thus had less population and land competition. But at the moment, the village condition is improved, accessibility during the dry season is possible, power supply and health center have been established. The least both average land holding, and woodlot size for Mninga village is due to relatively large population and the highest land competition in this village, where some land was taken by large-scale investors, including Sao Hill plantation forest and

Unilever Tanzania Tea estates. Indeed, it is a well-established fact that household decision to establish woodlots is also influenced by the level of landholding (Oduro et al., 2018; Nsiah & Pretzsch, 2010).

5.1.3 Educational level of the woodlots owners

According to Oduro et al. (2018) and Nsiah & Pretzsch (2010), the level of education attained by the head of household passively influences household decision making on woodlots establishment. However, in this study, no significant difference was observed when a Wilcoxon test was employed to test whether the level of education of the woodlots owners had significant influence or not on woodlots performance. This is because formal education (primary and secondary education) does not provide specific skills related to woodlots establishment and management. Tree planting and management is not part of the curriculum of primary and secondary schools in Tanzania. These skills are only provided in specialized technical training colleges and universities of which none of the selected respondents in the three villages had attended. This calls upon the need for trained forest personnel/extension officers to provide technical support of smallholders in tree growing. Provision of forest extension services would contribute to increased technical knowledge among smallholder tree growers and hence improve woodlots performance and productivity.

5.1.4 Age of the woodlots owners

There is a relationship between age and woodlots ownership by smallholders. In Igowole and Mninga a large number of studied woodlots owners were aged between 31 to 40 years. This discovery is inline Singunda (2010), who reported that in Mufindi district the majority of the woodlots owners were aged between 31 to 45 years. This means the tendency and motivation to invest in woodlots were high among this age group. In rural areas, people who fall in these age group are the main source of manpower (in labor and manual work), are highly engaged in the economic production and have access to land through both inheritance and purchase. In addition, these age groups have a large choice of family labor allocation, select the best return ones, and use their own land for less labor-intensive crops (the trees). The aforementioned facts make woodlots investment a sustainable economic activity in the study area.

Moreover, according to Deegen et al. (2011), the forest is normally a medium to long-term investment. This age group needs short-term returns, to feed their children, pay school fees, buy land, and build better houses. But, a person investing in woodlots at the age of 31 to 40 years, will reap the return at the age of 51 to 60 years, if rotation period is 20 years for tree species like pines. Such tree growers may use the return as their pension and/or reinvest in woodlots as they have money to pay for investment cots. Thus, the author suggests a minimum age of 20 years as the best age to encourage and promote woodlot investment. Because at this age, the tree grower can have a chance to harvest up to two 20 years rotations (at 40 and 60 years) before the elderly age of greater than 60 years when manpower declines. Young people provide active labor force and permit new skills necessary for forest management and improved production. Increasing

participation of young people in forest woodlots is therefore crucial for the sustainability and growth of rural economies.

However, Auch, et al. (2014), assert that it is difficult or impossible for rural poor farmers including youth to undertake forest investment. Such argument necessitates the government and other interested partners to give capital incentives to tree growers which will also promote youth engagement in woodlots. Not only that but also this can help tree growers to extend rotation periods by giving additional income while waiting for adequate trees maturity.

On the other hand, a large number of sampled woodlot owners at Nundwe were aged between 41 to 50 years. These differences were largely contributed by the inaccessibility and lack of important services such as health services in the past which made the village unattractive for youth. In all the three villages, woodlots ownership among respondents declined after 60 years. Similar findings were reported in Singunda (2010) and Nsiah & Pretzsch (2010). After the age of 60 years, sampled respondents were not doing such long-term investments for their own, but rather for their descendants and land security. This could suggest two major facts: Firstly, the elderly persons will normally live longer to enjoy the returns from tree plantation investments because of relatively long rotations, for example, 20 years for *Pinus patula*. And secondly, tree plantation investment requires relatively higher initial cost especially at establishment stage to pay for land preparation, nursery seedling production and planting such that elders can neither afford the cost (time and money) nor provide adequate labor.

5.1.5 Gender of the woodlot owners

In comparison, more woodlot owners were male-headed households than females headed ones. Such a pattern was large because traditionally most of the households in the study area and as a typology of African culture are headed by men (Singunda, 2010). Similarly, in Ghana, it was observed that men were more involved in on-farm tree planting than women (Insaidoo et al., 2012, Nsiah & Pretzsh, 2010). Male dominance in such long-term investments like woodlots is attributed to traditional land ownership system, which permits only men to own land (Adane, 2016). Like in most African countries, land was mainly owned by men in the study area. It is considered that a female will find land to the side of husband after marriages (Nkwera, 2010). However, in Mninga and Nundwe the proportions of female-headed household (12.5% and 20.8%) revealing a change in trend, although part of this proportion was also constituted by single mothers, divorced and widowed households as well as households with only female members. The change in trend could also be due to increasing awareness of female rights and change in land acquisition systems from inheritance to increasingly buying. This change in the traditional land ownership trend in society can be sustainable and have a positive contribution to woodlots development in the future. This is because the land acts; The land Act No. 4, 1999 and The Village Land Act No. 5, 1999 of the United Republic of Tanzania, equally allow both males and females to own land. And these legal provisions have the basis for

female rights and other civil society organizations for their advocacy about female rights to own land in Tanzania. As such, gender differences have an effect on land access, tenure security, and sustainability which altogether, in turn, if not well addressed can negatively affect woodlots establishment and development.

5.1.6 Household size and sources of labor

The size of the household of a woodlot owner influences the woodlots performance. This is because household size provides the family labor necessary for woodlots establishment and management. Household size also determines the family man-power and influences the production decisions (Nsiah and Pretzsch, 2010). In the absence of a reliable labor market in most African rural areas (Insaidoo et al., 2012), the amount of family labor force possessed by the household determines its ability to participate in economic activities including woodlots. In the present study, most of the respondents had a household size between 5 to 8 persons. This indicates the availability of labor to sustain woodlots establishment and management. This is one major reason that the majority of the study respondents were using family labor or at least combining between family and hired labor. Whereas only a few respondents exclusively used hired labor. Some reasons for hiring labor was lack of family labor due to engagement in other production activities, small household sizes such as elders whose children were already living an independent life and young couples with a fewer number of children and dependents. Household size, influences household decision making to establish and manage woodlots (Insaidoo et al., 2012; Nsiah & Pretzsch, 2010).

Most woodlots management activities such as pruning, fire line clearing, and slash weeding were carried out at the end of the rainy season or beginning of the dry season when most crop production activities had ended. Majority of farmers depended on rainy fed agriculture system in the study area. That means, family labor becomes available in most households. During this time the opportunity cost of family labor becomes zero, thus the main reason for most households for using family labor. Household members including children aged (6 – 17) years constitute family labor (Nsiah & Pretzsch, 2010). However, with currently established secondary schools at ward level, almost everywhere in the country, including the study area, the majority of children are attending secondary education, making family labor unreliable despite the relatively large household sizes.

On the other hand, buying in hired labor is limited by household cash availability. Payment of hired labor was done per day, between USD 22 to 30 per hectare. While the cost when payment was done per hectare was about USD 32.6 per hectare. The cost per day seemed somehow low because most woodlot owners work together with a hired person and the food was supplied by a woodlot owner. This system was more preferred by most farmers as effective in terms of cost and supervision. However, in hired labor per hectare, the woodlot owner only showed the woodlot area but did not accompany the laborer and did supply food,

thus accepted the higher cost. This system was more used by people who had limited family labor and more engaged in other productive activities such as casual laborers, businessmen, and government employees. Some of woodlots activities which require more labor included, land clearing, land tilling and pitting and planting. It should be noted that most works that required hiring extra labor are those involved in woodlots establishment. And a few such as pruning and fire clearing were less used hired labor because of their seasonality. It can be inferred that; woodlots establishment and harvesting activities are more labor-intensive than woodlots management activities.

Compared to agriculture, farm forests remains lucrative in terms of the return per unit family labor, but not in the absolute turnover per unit of land (Auch, et al., 2014). This is because most forest activities are relatively less labor intensive as compared to normal agriculture. Thus, tree growers who make proper seasonal family labor planning and allocation can reduce investment cost and get proportionally higher incomes. The use of hired labor in smallholder woodlots management is not common and literature is scarce in the country and entire East Africa. Some of the reasons for this could be due to the fact that, first, the woodlots activities are seasonal and relatively less labor intensive. Second, the majority of the smallholder tree grower households have large household sizes that supply enough labor. Third, smallholders have small average landholdings that make them either allocate small plots for farm woodlots or integrate trees with crops (agroforestry) and conveniently managed by family labor. Because of missing data on hired labor for smallholder woodlots, future study to determine the actual demands is imperative for detailed analysis and woodlots development planning.

5.1.7 Sources of seedlings

The quality of planting material is one of the key factors that determine the successful performance of trees in woodlots (Gregorio & Herbohn, 2010). The majority of the unorganized tree growers in Igowole, Mninga, and Nundwe villages bought seedlings from nursery operator farmers in the villages who raised them from locally collected tree seeds. Some of the reasons for using local seedlings from nursery operators farmers were: higher cost to buy certified quality seedlings, travel distance for farmers to follow the seeds in the TTSA shop in Iringa regional headquarters and lack of awareness of the benefits of using high quality planting stock. Majority of the farmers assessed the quality of seedlings by the ability to germinate when planted and quantity of seedlings raised in tree nurseries. It is well acknowledged that seedlings raised from locally collected seeds without technical recommendations do not have guaranteed quality (Näsholm et al., 2014). This is because quality differs depending on the quality of the mother trees in which they were collected. Therefore, such seedlings do not guarantee good growth performance that ensures the yield of quality products (poles and/or sawn timber). According to Gregorio & Herbohn (2010), a local tree can better be adapted to climate condition but may not necessarily possess quality traits both physically and genetically. That means, such trees may possess poor quality traits, and may grow with many and large

branches, large canopies, short internode length, many nodes and low bole expansion in time lowering the quality of the wood meant for timber and poles as well as extending rotation period (Näsholm et al., 2014; Gregorio & Herbohn, 2010). Thus, a low-quality seedling is not worth planting because it will produce a low-quality tree, even if it is provided with the appropriate silvicultural treatments and planted in an appropriate site (Gregorio & Herbohn, 2010)**.** On the other hand, the majority of the organized tree growers received seedlings and seeds from certified sources supported by different organizations. The certified source meant here is the Tanzania Tree Seed Agency (TTSA), which a public agency responsible for the supply of quality tree seeds in Tanzania.

The survival of trees, growth performance, length of rotation period and volume and quality of timber that can be harvested from a plantation including woodlots are greatly influenced by the quality of seedlings used (Gregorio & Herbohn, 2010). Conversely, a high-quality seedling provides minimal plantation management cost because of low seedling mortality and the less intensive management needed. That means, the planting of high-quality seedlings provides an early return on investment because they have more rapid growth, hence rotation period can be shortened (Gregorio & Herbohn, 2010). This is important for the tree growers to reduce management cost and provide better returns.

5.2 Farmer's motivations to plant trees

Smallholder tree growers plant and manage trees for various reasons. In this section, the study presents the reasons that motivated smallholder tree growers to plant and manage trees.

Economic related motivations

The need to generate incomes was a push factor for people to establish and manage woodlots. Financial benefits gained by farmers who planted trees in the past, after selling timber and poles from their woodlots, inspired most of the current farmers to also plant and manage trees. Despite the relatively long waiting cost, trees proved to have better and more stable prices than other farm crops. Based on interviews, trees are considered equally important to other food and cash crops. Instead of calling "tree planting", respondents are calling it "tree farming". Meaning that formally people called it "tree planting" and the tendency was that people just planted trees and did not care for them. But currently, "tree farming" means encouragement is given to planting and caring for trees as crop resource for future income. Also, the living expenses are high, as demands for facilities such as better housing, better schools for education (private and public schools) and utility items such as TV set and mobile phones have increased. For example, the insistence for education has largely increased among all villagers and some of the villagers are taking children to private (English medium primary) and secondary schools with better learning environment but involving higher costs. Unlike in the past. Although, education in public schools from primary to secondary school is free in Tanzania, but there several direct costs that parents have to incur as cost sharing. Such costs are relatively

higher for rural farmers without a good income base. Thus, farmers who planted trees in the past were able to manage these costs, while others were planting for future income for their children. On top of direct cash from selling the product, woodlots have also created extra employment opportunities in the value chain of wood including charcoal processors, carpentry workshops as well as timber and trees trade brokers in the village thus providing an additional source of income.

Similar findings were presented by Oduro et al. (2018), that financial benefits were the most significant motivation for tree planting by smallholders in Ghana. Also, a study by Etongo et al. (2015), in Burkina Faso, found that main reasons for farmers to plant trees was income generation from the sale of tree products, while others were; access to markets and seek local support for tree planting. In Indonesia, farmers were motivated to plant trees mainly for economic reasons (Kallio, 2013). In fact, income from trees provides additional economic security for unexpected expenditures such as health-related issues, death, marriage and act as a safety net during years of crop failures.

Financial saving reserve

Planting and managing trees are like bank saving. It is not easy for rural farmers to save money in cash. By investing in trees, the investment is paid slowly and with high increment in the older stages. Tree growers are able to get accumulated amount of money after selling of either standing trees or, by adding value through own labor, by harvesting the trees, processing and selling timber and or poles. Both the local people and people from other regions have taken woodlot product business. Buying both trees in woodlots and sawn timber from both pines and eucalypts, poles from eucalypts and transporting to sell in major town centers. Others are saw-millers and carpentry works have increasingly come in the villages. Thus, this gives an opportunity for tree growers sell their standing trees and/or harvested products and accrue financial returns in the accumulated way from their subsequent investments.

Land tenure security

Tree growers planted and managed trees to secure their land ownership rights. At the moment, farmers in the study villages possess untitled land plots. Thus, planting trees increase recognition for ownership, land values and protects from invaders especially for farmers who have more land area, more than they are able to cultivate other crops on yearly basis. In addition to that, some farmers had planted trees on the borders of their farm (borderline planting) to prevent encroachment by neighbors. In this study, it was also mentioned that people who have land and do not stay in the villages planted trees to keep their land safe. Similarly, this trend was observed to be practiced by older people who planted trees in the land that they are unable to use fully for crop cultivation as a means to secure it. Planting trees for land tenure security is practiced in several other countries in Africa and Asia. For example, in West Africa (Ghana, Nigeria, and Benin) smallholder planted cocoa trees on farms as one means to enhance land security (Fenske, 2011).

While in Ethiopia, land is owned by the state, smallholders planted *Eucalyptus spec*. to harness land allocation by the state and extend property rights over the entire period of tree growth (rotation period) (Munuye, 2018; Deininger & Jin, 2006). And, in Indonesia, integrated tree planting with rubber production among smallholder conferred stronger individual rights over land in weak and insecure customary land tenure systems of Sumatra societies (Suyanto, et al., 2001). That means, on top of all values such as wood supply and environmental amelioration, trees offer tenure security of land among rural smallholder farmers.

Environmental related motivations

Other motivations were grouped as environmental motivations, that included; planting trees as a mechanism to restore soil fertility for improved crop productivity and to conserve the environment. Farmers urged that nutrients deprived soils (from agricultural crop growing) if planted with pines, the fertility recovers to a large extent, similar to a fallow period. This farmers' perception and experience are in line with the scientific observation by Insaidoo et al. (2012), Larjavaara (2008) and Jagger et al. (2003) who also noted that certain tree species increased the soil fertility in farms. Some farmers planted pines and sometimes intercropped pines with maize as a means to restore nutrients in poor soils. Soils in the study area especially Igowole and Mninga villages was highly degraded by intensive and unsustainable use practices, predominantly monoculture through maize growing over decades, extensive use of inorganic or mineral fertilizers and lack of manure application. Tree planting especially *Pinus patula* was used to provide a fallow period for improvement of soil fertility for crop production in the next years.

Social status

Woodlot ownership is considered as a sign of household wealth and well-being in the study area. Tree planting has become well recognized economic investment and it is well known that investing in woodlots requires that one, has ready cash as capital to pay mainly for establishment costs, and patience of time while waiting for the trees to mature. This implies that only moderate to well-income households can afford such costs. This fact was similarly shared by Auch, et al. (2014), that despite the relatively higher return from farm forest investment as compared to crop farming its however hard or not possible option for extremely poor farmers in rural areas.

As a means to escape vermin animals

Farms surrounded by woodlots harbor wildlife species such as vervet monkeys (*Cercopithecus aethiops*) and common warthogs (*Phacochoerus africanus*). These wild animals are destructive to crops. Similarly, for the farms located in propinquity with Sao Hill plantations. Thus, crop farms surrounded by woodlots or in proximity to Sao Hill forest plantation experienced more crop raiding and destructions. That means such farmers were forced to change land use and plant trees in those farms to avoid crop losses. Although

woodlots is a means to restore degraded landscapes and revive lost habitats for biodiversity (Insaidoo & Rostonen, 2013; Insaidoo et al., 2012), it, however, presents an emerging human-wildlife conflict in future.

In general, the understanding the current motivations of farmers to tree planting and management is important for government, NGOs and development partners in the current and future planning to design programs that will encourage sustainable tree planting and management for improved farmer's income. As such, promoted smallholder tree planting and management can contribute to bridging the current wood demand and supply gap in the country and entire east African region.

5.2.1 Farmers planted tree species and preferences

The choice of tree species to be planted by smallholder tree growers depend largely on the use and non-use values, products and demands of such products in the market. In the study area, the majority of tree growers mainly prefer to plant *Pinus patula* tree species and to a lower extent *Eucalyptus spec*. largely in single species woodlot stands. Three main reasons were given for planting *Pinus patula*. Firstly, to improve soil fertility in that a pine harvested plot had observed to have higher crop yields. Secondly, the ability of farmers to change land use and plant other crops because, after harvesting, pines do not reiterate or sprout. And thirdly, pine when sold as trees or sawn timber had a good price as compared to timber from *Eucalyptus spec.* However, the higher tendency of monocultures among *Pinus patula* is revealing a potential risk of susceptibility to pest and diseases in the future. Thus, for sustainability, future studies to determine other suitable tree species on the basis of site conditions as well as economic and social acceptance are recommended. On the other hand, the main reasons for planting *Eucalypts spec*. were fast growth and maturity, no further replanting due to its ability to regenerate, and yield of multiple tradable products. For example, woodlots farmers were able to harvest Eucalypts from a minimum diameter (5 - 10) cm with the corresponding length of 3.6 m to 6 m for sale, similar to findings of a study by Munuye (2018) in Ethiopia. Such poles were used as withies, scaffolding and building support poles (PFP, 2016). Other uses for eucalypt pole were local house building by tree growers, loges and commercial huts making such as beer pubs in towns and cities. However, farmers who plant *Eucalyptus spec*. are fewer and mainly because of the two main disadvantages of *Eucalyptus spec.* that the farmers have experienced. First, the ability of *Eucalyptus spec*. to regenerate/sprout harvesting hence not easy to change land use after planting it or otherwise will require high labor and cost to remove the stumps. Secondly; nutrient depletion, as eucalypts harvested farms are reported to have low crop yields.

Against the background of high wood material demand, the domestic market for electricity utility poles preferring strong, long and large diameter (up to 40 cm) mainly eucalyptus species has remained strong (FDT, 2017, PFP, 2016). Moreover, the range of utility pole sizes has increased in the recent period with

the entry of a number of companies demanding "light poles[6]" for the communications industry on top of that of power transmission poles [7](PFP, 2016). This has increased the forest potential by allowing smaller and younger trees to be harvested either from thinning or clear-cutting. There is a need for providing correct information to woodlots farmers to increase the production of *Eucalyptus spec*. for purpose of utilizing the market potential, as a means of economic diversification as well as improving tree species diversity.

5.2.2 Household plans to plant trees in future and source of land

Tree planting in the study area started to become more active in 1998 - 2002 when a Danish International Development Agency (DANIDA) supported tree planting by a program called *Hifadhi Mazingira* [8](HIMA) in Iringa region. Since then farmers in this area have been planting and managing trees from time to time. The present study wished to additionally diagnose if farmers were still motivated to plant trees in the future and the sources of land for their future tree planting. The study found that all the woodlots farmers in the three villages had plans to plant trees in the future. However, their plans differed in time scope as well as their sources of additional land for future tree planting was varying. A large proportion of the respondents (45.8%, 58.3%) in Igowole and Mninga villages and 33.3% in Nundwe village have a plan to buy land for additional tree planting in the future. This is because these respondents do not have land left from future tree planting and they villages do not have extra land to allocate to farmers as reported in Nkwera (2010) and Singunda (2010). There is a need for forest extensionists to educate smallholder farmers to start considering agroforestry practices in future rather than the current practice of mainly managing purely trees with some practices of *Taungya* system that combines trees and crops in early stages, three to four years after planting. The fact from Nkwera (2010) and Singunda (2010), that land in the study area was mainly acquired through inheritance remains true for Nundwe village. That means in Nundwe village, woodlots farmers still have land available. This was also justifiable by the finding that respondents at Nundwe village had the highest average land holding (15.9 ha) as afore-discussed. Planting and managing trees in woodlots among smallholders, show sustainability in the study area. While supporting smallholder for further tree planting and management is expected to increase wood production and fix the deficit in wood supply (NAFORMA, 2015; Indufor, 2011; Ngaga, 2011), it is important to consider other factors such as tree growers future plans and limitations and adequately address them to avoid negative trends in the future.

5.2.3 Farmer's knowledge base to plant and manage trees

Knowledge on quality of seeds, seedling production, planting and tree management (silvicultural practices) is important for better tree growth performance. A large proportion of the studied tree growers had knowledge about land preparation, nursery management, tree planting, weeding, pruning, and fire

[6] Light poles = minimum length of 4.5 meters, and minimum top diameter of 10 cm
[7] power transmission poles = length of 9 to 14 meters, and minimum top diameter of 14 cm to 40 cm
[8] Hifadhi mazingira = a Swahili word that translates 'conserve environment'

protection. Big variation in knowledge between villages, highest Nundwe less in Igowole and the least in Mninga villages. This is because Nundwe village had organized tree growers (UWAMINU TGA) which managed a tree nursery collectively in a common site at the village. That made all members of the TGA learn seedling production practically, as well as for non-members of the TGAs to visit freely the nursery site to gain some skills. While ICFG TGA, unorganized tree growers in Igowole and all respondents in Mninga villages obtained seedlings produced by a fewer nursery operator farmers, thus no common ground for other tree growers to get the knowledge.

The study also found the disparity between tree management knowledge and practices. That means, what tree growers mentioned to know, was different from what they practiced in woodlots. For example, most of the tree growers knew the recommended tree planting space was 3 x 3 meters for pines and 2.5 x 2.5 meters for eucalypts trees planted for sawn timber. These recommendations are according to the Forest Plantation and Woodlot Technical Guidelines of Tanzania, in Mufindi (URT, 2017). But the physical measurement of planting space (both intra-row[9] and inter-row[10] spacings) using a tape measure (Figure 21, Annex 4) revealed different results. More of the tree growers in all three villages were planting between 2 x 2 and 2.5 x 2.5 meters. This means although tree growers knew what experts are recommending the decision or the real practice for tree spacing was based on other factors. It, however, tempting to argue that, in most cases, training was theoretical and conducted indoor, farmers were not able to follow the measurement protocol or use the measurement tools. Practical oriented training would have provided the necessary skills to build real practical understanding especially when trainers demonstrate the use of measurement tools and handling of things. In this study, most tree growers were measuring planting spacing by pace stepping, assuming one step to be equivalent to one meter. The steps, however, vary between individuals, making it impossible to maintain the same planting space even on the same farm. This, therefore, calls for more practical training to impact the required knowledge to rural farmers.

However, farmers were also reducing planting space as a strategy to increase the number of stems per unit area. Those planted on a wider spacing, on the other hand, did so to leave space for planting other crops such as maize (*Taungya* system) in the first three to four years of trees growth after planting. But, tree planting knowledge especially planting spacing regimes, play an important role in tree growth since they influence the quantity and quality of wood produced (Zahabu et al. 2015). Tree planting space differs depending on species, location as well as on purpose. Majority of woodlots assessed in the present study were pine woodlots. Thus, based on 3 x 3 meters as a standard spacing for pines planted timber production, a good planting space was evaluated for farmers who had planted at least at a space of (2.6 m and above) planting space.

[9] Intra-row spacing = distance from one tree plant to another in a row
[10] Inter-row spacing = distance between rows

Wider planting space can give better growth and stem diameter expansion of trees, due to reduced competition, especially for light and water. According to Malimbwi, et al. (1995), increasing planting space had positive effects on breast height diameter, basal area and volume production of *Pinus patula* of Rongai government plantation in Northern Tanzania. In addition, thinning schedule (commercial thinning) for softwood such as pines in Tanzania is based on an initial spacing of 2.5 x 2.5 meters and has four thinnings starting at age of 9 -11 years depending on site class (Malimbwi et al., 1995). At wider spacing for example, 3 x 3 meters or higher, it is possible to practice a 'no thinning' regime while maintaining the production of large size saw logs at a rotation age of 25 years (Malimbwi et al., 1995; Malimbwi, 1987), however, pruning is more necessary in this case. Despite the fact that majority of tree growers plant trees at 2 – 2.5 meters spacing, none of them carried out thinning instead they harvested by clear-cut at the age 8 – 12 years. At such spacing, it is also possible to achieve optimum productivity by adopting commercial thinning from 9 years and extend rotation up to 25 years among these smallholder woodlots in the study areas. It is paramount important that future extension work in the study area, should additionally focus on training tree growers on forest growth principles and dynamics, on objectives for the product of the plantations and influence of tree spacing on such desired products which are missing in the current practices.

5.2.4 Farmers source of knowledge to plant and manage trees

Tree grower associations (TGAs) were the main source of knowledge for the tree growers at Igowole and Nundwe villages. This is because most support organizations preferred to support tree growers organized in TGAs, like UWAMINU and ICFG TGAs in Nundwe and Igowole villages respectively were supported by training and other resources. But at Mninga village all tree growers were not organized, thus only a few tree growers had received training from various programs by support organization in the village, but the majority of the respondents had planted and managed trees by learning from other farmers including the nursery operators, from knowledge gained by working in Sao Hill forest plantations and by their own experiences. In addition, Sao Hill has an extension department to support smallholders. Nevertheless, interview with the Sao Hill manager of division 3, Ihalimba Mr. Mshana, training mainly focuses on fire management and is conducted through village general meetings. Other trainings were conducted on individual or group demands.

Most support organizations did not like to support tree growers through the village approach because of long bureaucracy in reaching target farmers. The villages approach of farmers support was used in villages which do not have organized tree growers such as Mninga village. In such villages, support organizations do not have a direct link to tree growers, but with the village leaders (government). The normal procedure is that they have always to pass through the village leaders, then the village leaders have to coordinate the meeting with the tree growers. In addition, according to institutional interviews with some support organizations, the village support approach was difficult to maintain communication with tree growers,

difficult to monitor progress and less tree grower commitment. Nevertheless, supporting tree growers in TGAs was a highly effective way to reach many tree growers, easy to maintain contact by using their leaders, less bureaucracy, high member commitment, easy to monitor progress and achieve impact as most support organization are project-based thus limited by time frame. The interest of support organizations to support organized farmers has been observed in several studies on farmer's agricultural cooperatives. For example, in Reed (2016) revealed that members of agricultural cooperatives received more organizational support such as knowledge through training that motivated them to participate actively in the group. Also, according to a study by Darr (2008) in Kenya and Ethiopia, farmers through their group, innovations tend to disseminate more effectively vis-à-vis non-group networks. In addition, the advantage of farmer organizations is attributed to their dimorphic character combining the bridging and bonding effects of 'weak' and 'strong' ties (Darr, 2008). That means tree growers associations as farmers groups, are also an important source of knowledge among other things, and their effectiveness for mass extension methods was a reason for more preference by support organizations in the study areas.

5.2.5 Challenges that constrain farmers in growing and managing trees

The present study presented eight challenges that farmers were facing in woodlots farming in the three study villages. Below is a detailed discussion for each challenge in three study villages.

1. Fire

The fire was pointed and ranked as the main challenge in the three study villages. Yet, field assessment during RA revealed that fire incidences were less frequently and only a few respondents had woodlots that previously experienced a fire. TGA leaders and private nursery operators at Igowole and Nundwe villages also pointed out that as compared to the past, fire incidence has decreased due to increased awareness campaigns, participation of villagers in tree growing, adoption of fire protection techniques (Fireline clearing) and adoption of fire regulation in villages bylaws which imposes strong fines and compensation for loss caused by fire. However, the fact that farmers continue to list fire at top of threats, means they understood the potential economic risks associated with a forest fire. This fear or knowledge of fire is a good sign of awareness of the problem and potential associated risks thus tree growers are kept on preparedness to take necessary measures to avoid fire occurrence. Thus, weeding and fire-line clearing remain vital to avoid the higher risks of fire damage. Denser planting could technically be used as a fire management strategy especially for ground fires, as it suppresses weeds earlier.

2. Inadequate knowledge

Low knowledge of planting and managing trees in woodlots among smallholders contributes to poorly performing woodlots. This is because low knowledge contributes to poor ways in which trees are plated and manages thus leading to produce low-quality products. Smallholder woodlots produced trees are

usually characterized by a small diameter, knots and not straight (CIFOR, 2015) as most farmers do not use appropriate silvicultural practices (CIFOR, 2015). Some of the recommended silvicultural practices include appropriate planting spaces of at least 3 x 3 meters, thinning at five years before the onset of competition and pruning (URT, 2017). In the study area, most tree growers do not have adequate knowledge to manage trees properly. For example, knowledge about the use of important silvicultural practices such as thinning and planting space to improve growth, timber quality and quantity is still missing. Although, pruning was done, knowing how to prune and how much of the green crown should be pruned as well as tree reaction to pruning effects such as wounds was not known among tree growers. In addition, knowledge about the importance of collective timber marketing, market and price information network as well as the importance of linkages with timber industries was missing. Thus, for improved and sustainable woodlots development in the study area knowledge on tree planting, management, harvesting time and marketing is important and therefore need to be strengthened in the future by both stakeholders including government and support organizations.

3. Lack of quality/improved seeds

Majority of the farmers use propagation material from local plantations of unknown quality and not-certified. This could be due to firstly, limited funds to buy quality and improved seeds from known sources, which are sold relatively more expensive than locally produced seedlings. As justified by private woodlot operators, that quality seedlings were sold more expensive USD 0.2 per seedling as compared to USD 0.04 per seedling for the locally produced seedling. Most farmers bought cheap and locally produced seedlings since the focus was more on price difference rather than quality. Secondly, farmers lack knowledge on the importance of using improved or quality seedlings as a necessary requirement in improving woodlot trees growth performance and products quality. These two aforementioned reasons can account for poor woodlots performance among smallholders in the study area. Thus, to improve woodlots performance future support organizations have to address the access to quality seeds and planting materials among other challenges.

4. Low timber prices

Woodlots harvested timber from smallholder farmers were sold at lower prices. To date, timber is the major product that smallholders are able to sell from their woodlots. Although the majority of the farmers sell standing trees, the price of the trees depends on existing timber market which is highly influenced by traders and middlemen. This is because first, the majority of the tree growers harvest or sell their trees at the age between 8 to 12 years (Singunda, 2010) before the optimum maturity and size are reached, due to financial constraints, a common problem for smallholders (Kallio, 2013; CIFOR, 2015). This in turn results to low quality is due to tree immaturity and poor management making them small in diameter, with knots and not straight (CIFOR, 2015). The second reason for low timber and tree prices is due to a lack of bargaining

power and collective product selling. Majority of tree growers are unorganized and only a few tree growers are organized, thus the organizations (TGAs) do not have a strong voice and bargaining power because tree growers are selling their timber and trees on individual agreements and negotiation with the buyers/traders. This is because only a few members (30 households) such that cannot maintain strong bargaining power against buyers coming for low prices because several other tree growers are not members and therefore acceptable to sell their trees and/or timber on an individual basis.

It is important that tree growers be sensitized enough to know the importance of organizing into TGAs for many benefits including collective timber or tree selling through TGAs which can improve bargaining power, price, and standardization of products. On one hand, the option to improve price and returns for tree growers are selling sawlogs but is not commonly practiced because traders do not want to buy saw logs. On the other hand, selling of sawn timber could be the best option, but most tree growers do not own sawmills. Sawmills are mainly owned by business people who hire and charge the milling cost of per piece of sawn timber depending on the timber size. Due to lack of experience, sawmill operation knowledge, and sawmilling labor management, some farmers feel costly and time-consuming in case of quick money demands.

5. Inadequate capital

Tree growers do not have enough money to properly manage the woodlots investment. First, to extend the woodlots areas by buying additional land or paying initial establishment cost which usually relatively higher. Second, to properly and timely carry out most/all management operations such as pruning and fire line clearing. And third, to adopt appropriate management, harvesting and timber processing technologies. All the tree grower trees were sawn by mobile sawmills (ding-dong) with low recovery rate (20 - 35) %, making most of the wood party lost as waste (Figure 25, Annex 4). In addition, all tree growers in three villages were pruning their tree using panga/machete (Figure 20, Annex 4). The efficiency of panga pruning depends on the person using it. It was observed that many pruned trees had some large pruning wounds which were caused by imperfect pruning practices including stem peeling. Such wounds could contribute to poor bole quality that in turn affected timer prices. With mobilized good capital or supports in TGAs with better pruning tools, quality seeds, timely fire management and investment in a stationary modern sawmill with higher recovery rate can increase farmers profit, improve their income and motivate them to plant and manage trees in woodlots. But investment in a stationary sawmill for smallholder woodlots requires pre-fulfilled conditions. Some of these conditions are: First, accessibility of woodlots by roads to reach by tracks to transport saw logs from woodlots to the sawmill. Second, the quality of saw logs be improved and long-term supply is assured. And third, the willingness of the tree growers to abide by quality criteria such as extend rotations to harvest mature saw logs.

6. Vermin animals

Monkeys and bush pigs destroy trees in smallholder woodlots. While, Monkeys destroyed trees by bark stripping, cutting and eating pine growth tips of *Pinus patula*, bush pigs were digging in newly planted seedlings of both Pinus patula and eucalypts in Igowole and Mninga village. A similar finding was reported in Maganga & Wright (1991) study, whereby blue monkeys *(Cercopithecus mitis)* in the Sokoine University of Agriculture Training Forest in the Mount Meru Forest Plantations in Arusha, northern Tanzania. According to Maganga & Wright (1991), the impact of monkeys was more extensive on *Pinus patula* than on cypress *(Cupressus lusitanica),* but the intermediate pine trees were damaged more than dominant trees, whereas dominant cypress trees incurred the most damage. This challenge was reported as a new experience in the study area that did not exist in the past years. This is because of the increased number of forest cover that provides a better habitat for the wildlife. An ecologically positive impact, but socially and economically negative to woodlots farmers in the study areas thus, calling for attention for the future of woodlots.

7. Land scarcity

For smallholder to invest in woodlots, land is the first prerequisite. Despite the fact that, farmers had plans to plant trees in the future, the majority of them were lacking land for future tree planting and extension woodlot areas because land is scarce. This was more observed in Mninga because of strong land competition in this village and most woodlots owners were characterized by average smallest landholding as compared to other study villages. In all villages, the farmers had to buy land in and/or to other villages for extension of woodlots and some were replanting harvested woodlots. In all villages, free village land allocation is no longer available as reported by Singunda (2010) and Nkwera (2010), but some individuals have private land available for selling on demands in all villages. And the sold plots are relatively small. That means the woodlots investment costs in the future, will include the cost of buying land, which is likely to be higher than the present. In the past, the majority of woodlot farmers inherited land from their parents (Nkwera, 2010, Singunda, 2010). Land scarcity is also caused by increased land value attributed to increased interest and motivations of farmers to plant and manage trees in woodlots in the study areas. In Ethiopia, the majority of smallholder farmers are characterized by small average landholding of less than one hectare (Bezu & Holden, 2014). According to FAO[11], smallholders in many sub-Saharan Africa are characterized by small average landholding of less than one hectare. For example, Kenya (0.53 ha), Uganda (0.97 ha), Ethiopia (0.78 ha), Malawi (0.47 ha). This phenomenon limits the area to dedicate for woodlots, thus its recommended that trees should be integrated with other crops (Agroforestry).

8. Infertile soils

[11] www.fao.org/family-farming/data-sources/dataportrait/farm-size/en/

Normally, very poor soil fields and unproductive for crop production were dedicated for tree planting by the majority of tree growers in the first priority. Poor soil is attributed to long-term unsustainable farming practices without appropriate soil conservation knowledge, presenting one failure of agricultural policies to address the problem. Many farmers planted trees in such poor soil land as a means for soil fertility restoration. According to tree growers, trees experienced slow growth rate especially at a young age because of deprived nutrients in the soil and lack of fertilization. While fertilization by using especially manure during planting is recommended to boost growth but only a few farmers owning livestock used it in the study area. However, planting trees for improving nutrient deprived soils is also acknowledged by many other studies in other countries such as in Ghana, Burkina Faso and Kenya (Oduro et al., 2018; Etongo et al., 2015; Oeba et al. 2012).

5.3 Farmer's preferred and planted tree species

The main purpose of planting and managing trees in woodlots was timber production. But on top of wood production, farmers had other qualities for species selection and preference. With references to these respondents, the most preferred and planted tree species in all three villages was *Pinus patula*. Three major reasons for preferring *Pinus patula* were given: (1) good timber prices; that pine timber has a higher price than other tree species. (2) The ability of pine tree to improve soil fertility; that pine harvested woodlots provide high crop yields. And (3) the possibility to change land use because pines do not reiterate/sprout after harvesting. The fact that *Pinus patula* improves soil fertility in the study area was also reported by Singunda study (2010).

Other tree growers preferred both *Pinus patula* and Eucalyptus species. The main reasons for eucalypts preference were: Firstly; fast growth; that within a short time (from 3 years) farmers can harvest tradable products such as construction poles. Secondly; coppicing ability; that after they had planted ones there was no need of replanting again. And thirdly; yield of multiple products such as poles (construction and transmission), timber and firewood. However, tree growers mentioned some reasons against Eucalypt species as degrades soil fertility; that Eucalypt harvested farms have poor crop yields, and that Eucalypts coppicing ability makes it difficult to change land use such as substitution to crops, otherwise would require enormous manpower to dig out remnant stumps from harvested Eucalypts.

Even though *Acacia mearnsii* (black wattle) was known for soil fertility improvement and an important source of fuel as firewood and charcoal in the study area, only a few farmers had managed it in eucalypts woodlots at Igowole village. And no tree grower was planting *Acacia mearnsii.* This was because of its invasive characteristic, that had been rapidly invading every land, and became the main weed tree in most farms so, farmers stopped planting and managing it in woodlots. At the moment, black wattle is still harvested on fallow lands, open public lands and delayed culling/weeding in woodlots. It is important to note when proposing new tree species to woodlots farmers considerations should not only base on the

product market, but also on other qualities such as social and/or ecological impacts that could otherwise affect their preferences and hence species acceptability.

Another study recently reported that pine the most planted tree species in smallholder woodlots (65%), followed by eucalyptus (20%) while the balance being made up teak and black wattle (PFP, 2017). That means country wide the tree growing is dominated by pines. This can be demand driven. Construction sectors are the main consumer of wood demanded in the country (NAFORMA, 2015), and pine timber is the most used sown timber especially for buildings construction. Thus, pine is more promoted by different stakeholders in almost all potential areas of the Southern Highlands of the country. The changing of agricultural land to forest presents increasing forest improvement that can contribute to an increase in wood supply, improved incomes of the tree growers and environmental improvement in the future.

5.3.1 Framers woodlot's tree species products and utilization

Smallholder woodlots provide different products, services, and amenity benefits. Based on the current study respondents in all the three villages, the products from *Pinus patula* were timber, slabs, and firewood. At the moment sawn timber was the main tradable product that has a commercial value in pine woodlots. This is because other products have less or none commercial value. For example, slabs; are either available for free use by the local farmers in the area as fencing materials and firewood or sold at only about USD 13 per full cargo truck to non-resident traders who come town centers. Slabs were also used for the construction of wooden fences, animal keeping houses (cattle, goats, pigs and chicken and small business huts. Eucalypt products included; poles, timber, slabs, and firewood. As such, poles, sawn timber and firewood from *Eucalyptus spec.* altogether had commercial value, as all these products are available in the market (Figure 23, Annex 4). Like for *Pinus patula*, eucalyptus slabs were used for construction (Figure 22, Annex 4) while others with more wood content were sold for use as firewood. Despite fewer preferences caused by undesirable features in the soil, *Eucalyptus spec*. had more tradable products than *Pinus patula*. That means, Eucalypts was sought to be more economically profitable than other preferred tree species. The products from black wattle tree species were: charcoal, firewood, and poles. All these products were tradable. The use of black wattle as fuel (charcoal and firewood) is due to its moderate density with a specific gravity of about 0.75, splits easily when chopped (firewood) and burns well with a calorific value of 3,500-4,600 kcal/kg (Sanga, 2016)

During group discussion it was noted that black wattle is also used to produce ropes that can be used for tethering animals, tightening things and grass house constructions. According to Sanga (2016), the bark of the wattles was used for industrial tannin production and poles for industrial power production in TANWATT factory in Njombe and Lion wattle factory in Lushoto located Tanga region in Tanzania. At the moment, there is no industrial use of the black wattle in the study area.

In addition, the farmers have not realized the full potential from the woodlots, especially from pine species. This, coupled with low log processing technologies, leads the loss of a large amount of wood as sawdust and slabs, which at the moment has less market value. The majority of sawn timber processors are small entrepreneurs operating mobile ding dong type sawmills with low recovery rates of 20-35% (PFP, 2017) On the other hand, sawdust from all the tree species was un-used product, similarly pine branches and twigs were freely available for collection and use as firewood (Figure 26, Annex). Eucalypts firewood has commercial value. With better technologies, sawdust has the potential to produce marketable products such as briquette for heating energy or cooking. Briquette can contribute to improved energy supply in major consumer cities such as Dar es Salaam, Dodoma, and Iringa in which at the moment are utilizing charcoal from mainly natural forests (Indufor, 2011). Also, the mobile sawmills produce low quality sawn timber with low market prices. However, at the moment, investment in stationary mill processors is partly hampered by low quality, limited volume, and dispersed woodlots (FDT, 2017).

5.4 Tree grower's social capital

Social capital is an important attribute of social and economic development. Woodlot farmers social capital through networking between farmers and linking with support organizations have brought access to different resources to tree growers. These resources include quality seeds and seedlings, planting materials, knowledge through training, funding and organization of some tree growers into TGAs in the study area. This finding is in line with Jenke (2013), Woolcock & Narayan (2000) and Coleman (1998) who found that bridging social capital can facilitate access resources and services and has a potential contribution to collective action. Similarly, Darr (2008) and Bodin et al. (2006) argued that bridging social capital can increase access to new information and skills by linkage to external support organizations.

The nursery operator nodes

Nursery operator farmers have an important role in tree seedling supply to tree growers in all villages. They were tied to many farmers and highly trusted for their seedling production service, skills and experiences. They have been the traditional seedlings sources in the study area, before the TGAs. Nursery operator farmers are important nodes to consider for future organizational support related to the provision of improved seeds and planting materials. Nursery operators have two major potentials for future contribution in woodlots development. First, in the villages which do not have common land for joint nursery activities and TGAs, nursery operators can be used as support platforms by organizations for the supply of improved planting materials and seeds. Secondly, nursery operators can be used as asset members of the future promoted TGAs to support collective seedling production in organized farmers.

Tree grower association (TGA) nodes

TGAs play a bridging role between organized tree growers and the support organizations. Since most support organizations prefer to support tree growers through their TGAs, that means TGAs need to be promoted such that many tree growers in the villages join them to have a powerful voice to perform other roles. At the moment, TGAs support to farmers has mostly based on woodlots establishment and improvement in production through improved seeds, planting material and training on tree planting and management. But, if well understood and accepted by many tree growers it can move the next step to increase market information and connection, bargaining power, secure more funding and influence more policy and regulatory transformation for smallholder plantation forestry in the study area. That was through the bridging social capital, TGAs were able to access resources and services (Woolcock & Narayan, 2000; Coleman, 1998) and have potential to enjoy more the role of collective action if adequately promoted and structured. In addition, Bodin & Crona (2009), Darr (2008) and Bodin et al. (2006) both argued that social capital can increase access to information and new skills through bridging social capital established by linkage to external support organizations.

5.4.1 Tree grower's networks and woodlots performance

Social network is an important element of social capital. Organized farmers have more networks than unorganized farmers. For example, in (Figure 19, section 4.4.4.3) all the green spots (12 organized farmers) were linked to purple spot (TGA) for training, funding, money, seeds, seedlings, and communication in Nundwe and Igowole villages. Unorganized farmers (green spots) have fewer networks. Organized tree growers were more connected to the resources and services such as training, seedlings, funding, and money to the TGAs of which unorganized tree growers were isolated. A similar finding was presented by Reed (2016), that farmers in cooperative received more external supports than non-cooperative farmers from both government and NGOs in Senegal.

Unorganized tree growers were tied to for seedling resources with the nursery operator farmers and isolated in the training and improved seeds/seedlings that were provided through the TGAs. In addition, communication and information sharing existed mainly to nursery operator farmers (orange spots) and fairly less with organized farmers, except for ICFG TGA (Figure 17, section 4.4.4.1) in which communication and seedlings connected both organized and unorganized tree growers. That means unorganized tree growers had limited resources in terms of quality and quantity.

Nevertheless, support organizations prefer to support organized farmers in tree grower associations (TGAs), that means organized farmers were more linked to support organizations (bridging) receiving exogenous resources than unorganized farmers. Organized farmers received better resources such as technical training on tree planting and management, quality seeds, seedlings and planting materials, money and funding which were delivered by these organizations through their TGAs. These provisions provide one basic reason for

the better woodlot's management and thus good woodlot performance in organized farmers over unorganized ones.

Logistic regression analysis on R - software, revealed significant differences in woodlots performance among organized and unorganized tree growers. That means social capital through these networks, has contributed to improved woodlots performance through social networks of tree growers and collective action, trust development, and norms. Putnam (1993), pointed out that social capital features such as networks, norms, and trust that can improve the efficiency of society and organizations by facilitating coordinated actions. Thus, organized tree growers had more access to new knowledge, information, and quality seeds as well as planting material. This accounts as one of the major reasons for the difference in woodlots performance between organized and unorganized tree growers. That woodlots of organized tree growers performed better than woodlots of unorganized ones. TGAs already stands as an outstanding platform for supporting tree growers. Therefore, we can also say, if the majority of tree growers in the villages join TGAs, woodlots are more likely to perform better in the future.

But some reasons for having only a few farmers joined include; (1) TGAs system is still new, therefore some tree growers were not aware of the benefits of joining them (2) some registration fees (USD 8.7) and monthly fees (USD 0.4) scares some very poor tree growers and (3) some relatively better tree growers did not have time to attend the meetings and join collective activities of nursery management. According to RSA (2012), Darr (2008) and Reed (2016), farmers groups such as cooperatives have more access to organizational supports than individual farmers. Most organization prefer to support organized farmers to utilize existing group platforms such as reaching many farmers at a time. Also, farmers groups establish with support organizations through group leadership, less bureaucracy and easy monitoring of supported activities (Claridge, 2004).

Although, organized tree growers are governed by norms of reciprocity such as payment of registration fees, annual membership fees, obligation to attend meetings and collective action activities, the advantages the member receives in the advanced and actively cooperating group is by far much more than staying as an individual. Thus, this becomes a compelling reason to promote tree growers in the study area to join TGAs to utilize the full benefits such as strengthened market contacts, price bargaining power for trees and timber, knowledge gain and sharing as well as powerful voice to the political system in addition to that of social capital and collective action.

5.4.2 Social Norms

Norms are important elements in sustaining social capital (Lin, 1999). Norms in social capital studies refer to formal and informal rules regulating the relations including the sanctions, authority and other structural features (Lin, 1999; Schmid & Robison, 1995). In the present study, all TGA had constitutions as norms

which guided out the group members and documented do's and do not within the association (TGAs). In addition, the obligation to pay registration fees, annual membership fees, attendance to formalized group meetings and sanctions to a violation of rules present evidence of social capital as norms for TGAs. Norms determined active memberships as well as member commitment to the group. Thus, norms, in this case, were used as a platform for trust building and collective action (group) administration. Such group commitment generated trust to external (exogenous) support organizations. For example, to get funded by TaFF[12], UWAMINU TGA submitted registration certificate and TGAs constitution as requirements before signing a contract agreement with the TGA to agree on the plan implementation and proper funds management based on submitted fund application proposal. One of the obligations of TaFF was periodic reporting by UWAMINU TGA on use of funds disbursed by TaFF in the three installments. This is another example of norms that assured group commitment and created more trust to TaFF especially after proper compliance to the first funding in 2012 to 2016, attracted second funding in 2017 and a proper implementation of the signed contract may enable further funding of UWAMINU TGAs in the future. Thus, norms and trust enhance network locations that accrue resources necessary to forester collective action achievements (Lin, 1999). In addition, social norms build trust and enhance member commitment in a group. Therefore, norms are necessary pre-requisite for social capital.

5.4.3 Social networks, trust, and collective action

The higher the network density[13], the more the potential for collective action. Increased levels of collective action, increases possibilities for communication, that over time, results in increased levels of mutual trust and reciprocity (Bodin & Crona, 2009). In the present study, farmers organized into tree grower associations (TGAs) have more collective action, gained more trust between themselves as well as to the external organizations. That means TGAs promoted more bridging social capital. Coupled with trust, organized tree growers were able to attract more external supports which enabled them to implement their objectives in line with their plans. For example, UWAMINU TGA applied and won small grants from TaFF in 2012 to implement tree planting. The result of the successful implementation of their objectives attracted another medium grant in 2016 by the same support organization. Similarly, PFP and FDT provision of free training, improved seeds, and planting materials to TGAs in both Igowole and Nundwe villages. The joint tree nursery management by UWAMINU TGA in Nundwe village is another evidence of collective action which increased networking, social contact and cooperation, knowledge and experience sharing and mutual trust among tree growers and support organizations that consequently built more social capital.

[12] Tanzania Forest Fund, public agency responsible for provision of grants to groups and individuals to promote forest management and conservation in Tanzania main land.

[13] Network density = the number of existing ties divided by the number of possible ties

5.4.4 The impacts of tree grower's organizations on woodlots performance

Although, smallholder woodlots in the study area were generally reported performing poorly (FDT, 2017; FDT 2015; PFP, 2014; Ngaga, 2011), TGA membership of tree growers revealed significant positive influence on woodlots performance. The logistic regression analyses for the relationships between woodlots performance and TGAs membership revealed a significant difference in most assessment variables including the gaps, growth conditions and planting spaces. Similarly, descriptive statistics indicated organized farmers woodlots (TGAs) performing better than unorganized farmers. In fact, the better performance of woodlots among organized farmers is attributed to support organizations that the organized farmers are linked to. The reasons for this include; (1) TGA as a support platform: most organizations supported organized tree growers in TGAs by providing: free quality seeds, planting materials, funding and new knowledge through training (2) the role of collective action: organized tree growers have formalized norms that bring them together to communicate for new information through structured meetings in TGAs and the collective activities such as the joint nursery management by UWAMINU TGA at Nundwe village which facilitated knowledge and experience sharing (3) Bridging social capital: TGAs were more linked to exogenous contacts that brought in new technical knowledge suitable for plantation management. Such linkage has the potential to attract improved technologies for managing; for example, pruning and processing timber which currently missing. Tree grower - support organizations network was connected by some resources sought to be necessary to improve production efficiency. Congruently, Jenke, (2013), World Bank, (1999) and Putnam (1993) found that community networks are maintained by network resources which are necessary to facilitate the achievement of their collective as well as individual demands. These resources were increasingly getting availed among organized tree growers from the support organizations thus, contributed to better woodlots performance of the organized tree growers. Therefore, based on the results of this study, to achieve sustainable woodlots development and improved performance, organization of tree growers into TGAs is crucial in the study area.

5.4.5 The theory of social capital and forestry

Forestry activities are not implemented in a vacuum, but highly interlinked with other domains: social, cultural, institutional, economic, and political (Szulecka & Secco, 2014). Social capital enhancement becomes one of the key issues in studying and implementing forestry projects to local smallholders. Enhanced social capital can improve environmental outcomes through decreased costs due to collective action, increase in knowledge and information flows, increased cooperation, less resource degradation, and depletion, enhance forest investment, improved monitoring and enforcement and simplify coordination (Claridge, 2004).

Even though studies on the role of social capital in smallholder woodlots are scarce in the literature, but its role in the development of the sector remains crucial. The role of social capital in the present study manifests

itself from the networks established between individual tree growers, tree growers in groups (TGAs) and support organizations visualized through social network analysis of tree growers and associated actors. Networks established are due to demands for various resources necessary for woodlots establishment and management. Organizations show more interest in supporting organized tree growers in groups by supplying the required aforementioned resources. As the result, organized tree growers had better woodlots performance than unorganized ones. This finding was congruent to Szulecka & Secco (2014), who found that smallholder farmers with a high level of social capital exhibited better performance in landscape restoration projects in Paraguay. Similarly, Jenke (2013), found that communities managing natural forests accessed more resources and incentives from support organizations that contributed to more motivation and improved management. However, the successful contribution of social capital to woodlots development requires some pre-conditions to be fulfilled. These include the collective action of the individuals (groups) such as TGAs, norms; involving both formal and informal rules, regulations as well as sanctions and linkages. In the present study, these pre-conditions were fulfilled as obligations measurement group management and member commitment. Also, the mobilization of social capital requires a high degree of awareness to the societies involved in order to have positive effects (McHugh and Prasetyo 2002). Thus, social capital stands as a powerful tool of bringing the tree growers together, to share the resources which are normally scarce for smallholders, harness support, improve bargaining power and pose strong voice to gain political will in a particular area and context. These things can be necessary to fuel smallholder woodlots development.

CHAPTER SIX

6. Conclusion, Recommendations and Future Research Direction

6.1 Conclusion

Endogenous and exogenous factors affect smallholder woodlots establishments, management, and performance. Some of the endogenous factors are household landholding, sociodemographic characteristics of the household, knowledge and household resource endowment. Linkages to support organizations constitute the exogenous factors that provided a package of resources to supplement household resource deficits. These resources are technical knowledge through training, improved seeds and planting materials as well as cash money. Thus, endogenous and exogenous factors complement one another. Such complementarity is crucial for improved performance and sustainable development of smallholder woodlots.

Organized tree growers (TGAs) have more linkages to support organizations. The linkages to support organizations constitute more bridging social capital and exogenous influencing factors. The relationship among tree growers themselves constitutes more bonding social capital and endogenous influencing factors. However, the position of TGA whether on the exogenous or endogenous source of factors is challenging. But its formation is influenced by exogenous factors. The current woodlots establishment and development both bonding and bridging social capital have played an important role. Nonetheless, for improving woodlots performance, bridging social capital remains potentially important in the future.

Based on the study respondents, the main motivation for smallholders to plant and manage trees are economic-related factors such as financial gains from selling trees, timber, poles, and other products from woodlots. This also means tree farming has become a new form of business where people invest money on tree growing in hope to fetch more value in later years, just like cattle fattening. Also, farmers use woodlots as a means of financial saving. Other motivations are land tenure security, social status (sign of wealth and prestige), improving soil fertility and addressing current and future environmental challenges.

Sampled tree growers in the study area had the knowledge to plant and manage trees ranging from land preparation, tree nursery seedling production, planting, fire protection, and pruning to a large extent. However, knowledge on forest growth principles and dynamics, on objectives for the product of the plantations and influence of tree spacing on such desired products is missing. In addition, knowledge about nursery management and timely planting was very low among unorganized tree growers in Igowole and Mninga villages due to lack of collective action on tree planting activities.

The main tree species preferred and planted in the study area are *Pinus patula* and *Eucalyptus spec*. But the reasons for tree choice and preference varied between species. While the main reasons for planting *Pinus patula* are: good sawn timber prices, soil fertility improvement and ability to change crops or land use after

harvesting, the main reasons for planting *Eucalyptus spec*. are fast growth and maturity and coppicing ability; therefore, no need of replanting after first planting and production of multiple tradable products including poles, timber, and firewood. Although, some critics raised against eucalypts that *Eucalyptus spec*. degrade soil, because *Eucalyptus spec* harvested farms had lower crop yields. But those who planted *Eucalyptus spec*. argued that, it provides better returns than *Pinus patula*.

The main challenges constraining farmers in planting and managing trees are fire, inadequate capital, inadequate knowledge, lack of improved seeds, and low prices for standing trees and sawn timber.

Different organizations are supporting woodlots farmers in the study area. At Igowole village, organized farmers in ICFG TGA had been supported once by Private Forestry Program (PFP) for training, seeds and planting material in 2016. At Nundwe village, organized farmers in UWAMINU TGA are still under active support of Private Forestry Program (PFP), and Tanzania Forest Fund (TaFF). Most support range from training, provision of so the called improved seeds and planting materials, grants and support on alternative income generation activities such as village saving organizations and beekeeping. While unorganized farmers mainly bought locally produced seedlings from fellow nursery operator farmers in all the three villages. Other organizations which had supported tree growers were Forestry Development Trust (FDT), Soh Hill and Mufindi district council.

6.2 Recommendations

Based on the aforementioned research results, discussion and conclusions, this thesis recommends the following for theory and implementation.

1. Tree grower associations (TGAs) should extend their focus from current production centered to more market and business orientation. This will allow them to make more contacts with other business companies such as Green Resources Ltd. (GRL) and New Forest company to make partnership linkages. Such linkages are necessary to improve production, marketing skills and processing technologies in the study area.
2. NGOs and private companies should consider investing in better processing technologies, necessary to increase the recovery rate of wood processed from smallholder woodlots from 20% to 35% at the moment, to a higher level in the future. Such an investment will help establish standards of woodlots logs by sawmill demands thus proving a push to quality and productivity improvement in smallholder woodlots.
3. The government, NGOs and development partners should continue to encourage tree growers to form and join TGAs, to enable them to benefit from collective action and social capital. Because, collective action activities such as nursery joint management facilitate sharing and spread of knowledge among tree growers, while social capital will accrue resources from exogenous sources.

4. It is paramount important that future extension work (by government extensionists and stakeholders such as the Wood Cluster project) in the study area, should additionally focus on training tree growers on forest growth principles and dynamics, product objective-based woodlots/plantations and influence of tree spacing on such desired production which is missing in the current practices.
5. Government through the ministry of natural resources and tourism should provide a policy statement to recognized TGAs as a suitable smallholder plantation forestry model like other community participatory models applied in natural forest management necessary to foster woodlots development in the country. This will give room for legal recognition of TGAs as a community-based organization for smallholder forest management. Because, developed smallholder forestry has a potential to contribute more to increased wood production, improved tree grower's income, halt down illegal harvesting in both natural and planted government forests, safeguard the environment and mitigate climate change impacts.
6. Central and local/district governments need to simplify the tax regulations for timber sourced from smallholders. Indeed, such a step will to reduce transaction costs in smallholder timber marketing and increase tree growers profit. At the moment tax is considered charged on timber traders, but in reality, timber traders transfer all the tax charges to the tree growers through price reduction on trees or harvested timber.
7. As part of extension and learning, the summer field schools organized by Wood Cluster project in future, should focus on demonstrating the practical use of tools and relevance of the following aspects in plantation, including: how to measure planting space of trees planted for different purposes, how to do pruning, reasons and the extent of pruning, how to carry out management and commercial thinning as well as reasons for such treatment for stand performance.

6.3 Future Research Direction

Future studies by both local research institutions and partners such as Wood Cluster project should focus on the following research areas:

1. A study to assess current farmer's silvicultural practices is recommended. Such a study is necessary to find out specific silvicultural knowledge gaps and provide options for appropriate silvicultural options necessary to be adapted among smallholders. Recommendations from such studies can help to improve woodlots performance in terms of productivity and quality in the study area.
2. Since farmers prefer much to plant *Pinus patula*, further research on other suitable hybrid tropical pine species such as *Pinus elliottii* and *Pinus caribaea* is recommended. Such species are necessary to provide more species diversity and reduce risk in case of disease and pest occurrence in future.
3. It was documented that; the majority of sawn timber processors are small entrepreneurs operating mobile ding-dong type sawmills with low recovery rates of 20 - 35%. Therefore, the present study

recommends that a feasibility study to be done to find out reliability of investment in improved fixed wood processors (sawmills) and its capacity, long-term supply of wood material from smallholder woodlots and transport cost feasibility for logs from woodlots to sawmill location.

4. The present study presented the network and linkages as a social capital dimension and its contribution to woodlots performance by evaluating a representative sample of the TGA members to compare performance between TGA and non-TGA farmer's woodlots. However, to statistically justify the role of social capital to current woodlots development in the study area, detailed social capital study, taking a case study of a particular TGA (s) involving large samples or all members and actors involved is recommended.
5. A study to assess growth performance of smallholder woodlots and/or a comparative growth performance assessment between smallholder's woodlots and large enterprise (s) for selected main tree species grown in the study area including pines and eucalypts is recommended.
6. Tree growers assessed the quality of seedlings by the ability to germinate when planted and quantity of seedlings raised in tree nurseries. However, the difference in quality between locally collected seeds and improved seeds supplied by certified sources is equivocal. Thus, the present study recommends that further research to be done to test the qualification of local stands as seed trees.
7. It was found that in the study area *Eucalyptus spec.* in smallholder, woodlots had more tradable products than *Pinus patula*. And mentioned by some growers that eucalypts provide better returns than pines. But, the majority of tree growers preferred to plant *Pinus patula* than *Eucalyptus spec.* Thus, research on a comparative profitability analysis between *Eucalyptus spec*. and *Pinus patula* is recommended.
8. Planting space of trees affects the woodlots performance. Therefore, future study to evaluate the effect of spacing regimes on growth, yield, and wood quality of *Pinus patula* and *Eucalyptus spec*. in smallholder's woodlots are recommended in the study area.

7. References

Aberdeen, T. (2013). Case study research: Design and methods (4th Ed.). Thousand Oaks, CA: Sage. *The Canadian Journal of Action Research*, *14*(1), 69–71. Retrieved from http://journals.nipissingu.ca/index.php/cjar/article/view/73. Accessed on 13th Dec. 2018.

Adane, S. A. (2016). Barriers to Smallholder Plantation Development in Off-Reserve Forest Areas, Unpublished Master Thesis, Kwame Nkrumah University of Science and Technology Kumasi, Ghana.

Auch, E., Pretzsch, J., & Uibrig, H. (2014). *Organizational Changes in Forest Management*. in Pretzsch, J., et al. (eds.), Forests and Rural Development, Tropical Forestry 9, Heidelberg, Springer, Berlin, Germany. 111-144.

Agwanda, A., & Amani, H. (2014). *Population Growth, Structure, and Momentum in Tanzania*. Retrieved from http://esrf.or.tz/docs/THDR-BP-7.pdf. Accessed on 29 Oct. 2018.

Australian Bureau of Statitics. (2002). Discussion paper: Social capital and social well being, Melbourne, Australia.

Nsiah, B. and Pretzsch, J. (2010). The Contribution of Smallholder Forest Plantation Development To the Livelihood of Farm Households in the High Forest Zone of Ghana: A Dissertation submitted in partial fulfillment of the requirements for the degree of Doctor Rerum silvaticarum.

Berg, S. (1988) Snowball sampling, in Kotz, S. and Johnson, N. L. (Eds.) *Encyclopedia of Statistical Sciences* Vol. 8.

Bourdieu, P. (1986). The forms of capital. In: Richardson, J., Handbook of Theory and Research for the Sociology of Education. Westport, CT: Greenwood: 241–58.

Bodin, Ö., & Crona, B. I. (2009). The role of social networks in natural resource governance: What relational patterns make a difference? *Global Environmental Change*, *19*(3), 366–374. https://doi.org/10.1016/j.gloenvcha.2009.05.002. Accessed on 21st June 2018.

Bodin, Ö., Crona, B. & Ernston, H. (2006). Social networks in natural resource management: what is there to learn from a structural perspective? *Ecology and Society, 11*(2), 2

Bunting, P., Armston, J., Lucas, R. M., & Clewley, D. (2013). Sorted pulse data (SPD) library. Part I: A generic file format for LiDAR data from pulsed laser systems in terrestrial environments. *Computers and Geosciences*, *56*, 197–206. https://doi.org/10.1016/j.cageo.2013.01.019. Accessed on 12th Jan. 2018.

Carle, J., Vuorinen, P., & Del-Lungo, A. (2002). Status and Trends in Global Forest Plantation Development. *Forest Products Journal*, *52*(7), 1–13.

CIFOR. (2015). Center for International Forestry Research, Making timber plantations an attractive business for smallholders, Bogor - Indonesia, (114), 1–4. https://doi.org/10.17528/cifor/005515. Accessed on 12th August 2018.

Claridge, T., 2004. Social Capital and Natural Resource Management: An important role for social capital? Unpublished Master Thesis, University of Queensland, Brisbane, Australia.

Darr, D. (2008). *Effective Even When Neglected: Farmer Groups and the Diffusion of Agroforestry Innovations in Rural Communities of Eastern Africa*. https://www.researchgate.net/publication/322976408%0AEffective. Accessed on 12th July 2018.

Deegen, P., Hostettler, M., & Navarro, G. A. (2011). The Faustmann model as a model for a forestry of prices. *European Journal of Forest Research*, *130*(3), 353–368. https://doi.org/10.1007/s10342-009-0336-9. Accessed on 12th July 2018.

Deininger, K., & Jin, S. (2006). Tenure security and land-related investment: Evidence from Ethiopia. *European Economic Review*, *50*(5), 1245–1277. https://doi.org/10.1016/j.euroecorev.2005.02.001. Accessed on 14th October 2018.

Dempwolf, C. S., & Lyles, L. W. (2012). The Uses of Social Network Analysis in Planning: A Review of the Literature. *Journal of Planning Literature*, *27*(1), 3–21. https://doi.org/10.1177/0885412211411092. Accessed on 7th July 2018.

Duriau, V. J., Reger, R. K., & Pfarrer, M. D. (2007). Organizational Research Methods. https://doi.org/10.1177/1094428106289252. Accessed on 21st January 2018.

Dytham, C. (2011). *Choosing and Using Statistics: A Biologist Guide*. (C. Dytham, Ed.) (3rd ed). York, England: Blackwell Science.

Elia, H. (2013). Comparative Analysis of Profitability of Thinned and Unthinned Commercial Forest Plantations with and without Carbon Revenues. The Case of Plantations under Green Resources Ltd and Saohil Forest Plantations in Mufindi District. Unpublished Master Thesis, Mzumbe University, Morogoro, Tanzania.

ETFRN. (2015). *Europian Tropical Forestry Research Network "Effective Forest and Farm Producer Organizations" Tropenbos International, Wageningen, The Netherlands. ETFRN News* (Vol. 57).

Etongo, D., Ida, N.S.D., Markku K., and Kalame F. (2015). "Smallholders' Tree Planting Activity in the Ziro Province, Southern Burkina Faso: Impacts on Livelihood and Policy Implications," 2655–77. https://doi.org/10.3390/f6082655. Accessed on September 14th, 2018.

FAO. (2015). The economic lives of smallholder farmers: An analysis based on household data from nine countries, Rome, Italy. *Revista de Administração*, *52*(1), 114–117. https://doi.org/10.1016/j.rausp.2016.10.004. Accessed on 20th Jan. 2018.

FAO, IIED & IUCN. (2014). Roadmap for strengthening forest and farm producer organizations; A Policy Brief. *International Conference on Forest Producer Organizations*, 21. Retrieved from www.fao.org/partnerships/forest-farm-facility/83759a. Accessed on 25th Jan. 2018.

FAO, & AgriCord. (2016). *Forest and Farm Producer Organizations - Operating Systems for the SDGs; Strenght in Numbers*. Rome, Italy.

Faugier, J. & Sargeant, M. (1997) Sampling hard to reach populations, *Journal of Advanced Nursing*, vol. 26, 790-797.

FDT. (2017). "Forestry Development Trust; Tanzanian Wood Product Market Study, Final Report, Iringa, Tanzania."

FDT. (2015). Forest development Trust "*Baseline Tree Grower Survey Report" Iringa, Tanzania.*

Fenske, J. (2011). Land tenure and investment incentives: Evidence from West Africa. Journal of Development Economics, 95(2), 137–156. https://doi.org/10.1016/j.jdeveco.2010.05.001. Accessed on 14th October 2018.

Fletcher, R. H., Fletcher, S. W., Jiménez, V., Díaz De Salas, S., Mendoza, V., Porras, C., Noor, K. B. M. (1997). Case study as a research method. *Academy of Management Review*, *5*(2), 301–316. https://doi.org/10.1177/15222302004003007. Accessed on 11th Nov. 2017.

Gaur, A. & M. K. (2017). A systematic approach to conducting review studies: An assessment of content analysis in 25 years of IB research, Washington, USA. *Journal of World Business, Forthcoming*.

Gregorio, N., & Herbohn, J. (2010). Guide to quality seedling production in smallholder nurseries, VISCA Foundation for Agricultural Research and Development, Inc. and College of Forestry and Natural Resources, Visayas State University, Visca, Baybay City, Leyte, Philippines.

Gregorio, N., Herbohn, J., & Vanclay, J. (2006). Establishing Field Trials To Promote Smallholder Forestry. 75–81. Leyte, the Philippines: https://www.researchgate.net/publication/43515491. Accessed on September 15th, 2018.

Griffiths, P., Gossop, M., Powis, B. and Strang, J. (1993) Reaching hidden populations of drug users by privileged access interviewers: methodological and practical issues, *Addiction*, vol. 88, 1617-1626.

Grootaert, C., & Bastelaer, T. Van. (2001). Understanding and Measuring Social Capital: A Synthesis of Findings and Recommendations from the Social Capital Initiative. *Social Capital Initiative Working Paper*, *24*(24), 1–31. https://doi.org/10.1227/00006123-197907010-00058. Accessed on 2nd Feb. 2018.

Hanneman, R.A. & Riddle, M. (2005). Introduction to social network methods. Riverside, CA: the University of California, Riverside (published in digital form at http://faculty.ucr.edu/~hanneman/) Accessed on February 26th, 2018.

Htut, M. Yin & Pretzsch, J. (2018). An analysis of collective action in forest plantation establishment by FUGs (Case study in the dry zone of Myanmar) Introduction. https://doi.org/10.1017/CBO9781107415324.004. Accessed on 14th July 2018.

Held, C., Jacovelli, P., Techel, G., Nutto, L., Wathum, G., & Wittmann, N. (2017). Tanzanian Wood

Product Market Study. Final report for the Forestry Development Trust, Iringa, Tanzania.
Indufor. (2011). The United Republic of Tanzania Forestry and Beekeeping Division Private Forestry and Carbon Trading Project Timber Market Dynamics in Tanzania and in Key Export Markets Market Study, Dar es Salaam, Tanzania.
Insaidoo, T. F. G., & Rostonen, M. A. F. (2013). Governing the Provision of Ecosystem Services, *4*. https://doi.org/10.1007/978-94-007-5176-7. Accessed on 18th June 2018.
Insaidoo, T. F. G., Ros-tonen, M. A. F., Hoogenbosch, L., & Acheampong, E. (2012). Addressing forest degradation and timber deficits in Ghana. *ETFRN News*, 230–239.
Jagger, P., Pender, J., & Gebremedhin, B. (2003). Woodlot devolution in northern Ethiopia: opportunities for empowerment, smallholder income diversification, and sustainable land management. *EPTD Discussion Paper - Environment and Production Technology Division, International Food Policy Research Institute*, (107), 47–pp.
Kallio, M. 2013. "Factors Influencing Farmers' Tree Planting and Management Activity in Four Case Studies in Indonesia. Unpublished Ph.D. Dissertation, University of Helsinki, Finland.
Larjavaara, M. (2008). A Review of the Benefits and Disadvantages of Tree Diversity. *The Open Forest Science Journal*, *1*(1), 24–26. https://doi.org/10.2174/1874398600801010024. Accessed on 18th August 2018.
Lin, N. (1999). Building a Network Theory of Social Capital. *Connections*, *22*(1), 28–51. https://doi.org/10.1108/14691930410550381. Accessed on 16th August 2018.
Lollo, E. (2012). Toward a theory of social capital definition : its dimensions and resulting social capital types. *14th World Congress of Social Economics. 2012*, 1–30.
Maganga, S. L. S. & Wright, R. G. (1991) Bark-stripping by blue monkeys in a Tanzanian forest plantation, Tropical Pest Management, 37:2, 169-174, DOI: 10.1080/09670879109371569
Malinga, H. I. (2011). Management Cost in Government and Private Plantation Forests. Unpublished Master Thesis, Sokoine University of Agriculture, Morogoro, Tanzania.
Markelova, H., & Mwangi, E. (2010). Collective Action for Smallholder Market Access : Evidence and Implications for Africa, *27*(5), 621–640.
Maryudi, A., Nawir, A. A., Sekartaji, D. A., Sumardamto, P., Purwanto, R. H., Sadono, R., Riyanto, S. (2017). Smallholder Farmers' Knowledge of Regulations Governing the Sale of Timber and Supply Chains in Gunungkidul District, Indonesia. *Small-Scale Forestry*, *16*(1), 119–131. https://doi.org/10.1007/s11842-016-9346-x. Accessed on 10th Jan. 2018.
McHugh, R. & Raphael, J.P. (2002). "Social capital in Asia: A proposal for discussion." The International Scope Review 4.
Midgley, S. J., Stevens, P. R., & Arnold, R. J. (2017). Hidden assets: Asia? smallholder wood resources and their contribution to supply chains of commercial wood. *Australian Forestry*, *80*(1), 10–25. https://doi.org/10.1080/00049158.2017.1280750. Accessed on 10th Jan. 2010.
Munuye, A. A. (2018). Value chain analysis and identification of upgrading options for Eucalyptus poles and fuelwood in Sidama Zone, The case of Hawassa Zuria district, Southern Ethiopia. Unpublished Master Thesis, Dresden University of Technology, Tharandt, Germany.
NAFORMA. (2015). National Forest Resources Monitoring and Assessment of Tanzania Mainland, Dar es Salaam, Tanzania.
National Bureau of Statistics. (2013). 2012 Population and housing census; Population Distribution by Administrative Areas. *National Bureau of Statistics*. Dar es Salaam, Tanzania.
Ngaga, Y. (2011). Forest Plantations and Woodlots in Tanzania. *African Forest Forum*, *1*(16), 80.
Nkwera, F. E. (2010). The Influence of Timber Trading on Poverty Reduction in Mufindi District: Unpublished Master Thesis, Sokoine University of Agriculture. Morogoro, Tanzania.
Nsiah, B & Pretzsch, J. (2010). The Contribution of Smallholder Forest Plantation Development to the Livelihood of Farm Households in the High Forest Zone of Ghana: Unpublished Ph.D. Dissertation, Dresden University of Technology, Tharandt, Germany.
Oduro, K. A., Arts, B., Kyereh, B., & Mohren, G. (2018). Farmers' Motivations to Plant and Manage On-Farm Trees in Ghana. *Small-Scale Forestry*. 1–18. https://doi.org/10.1007/s11842-018-9394-5. Accessed on 17th Aug. 2018.

Oeba, V.O., Samuel, C .J.O., James.B.K. & Muchiri, M.N. (2012). "Modelling Determinants of Tree Planting and Retention on Farm for Improvement of Forest Cover in Central Kenya" https://doi.org/10.5402/2012/867249. Accessed on September 14th, 2018.OECD. (2007). What is social capital? *OECD Insights: Human Capital: How What You Know Shapes Your Life*, 102–105. https://doi.org/10.1787/9789264029095-en. Accessed on 2nd Jan. 2018.

Ostrom, E. & Ahn T. K. (2008). The Meaning of Social Capital and its Link to Collective Action, Workshop in Political Theory and Policy Analysis, Indiana University, North Park, Bloomington, USA.

Pima, N. E., Chamshama, S. A. O., Iddi, S. & Maguzu, J. (2016). Growth Performance of Eucalypt Clones in Tanzania, *4*(3), 146–154. https://doi.org/10.13189/eer.2016.040306. Accessed on 20th July 2018.

PFP. (2016). Private Forestry Programme – *Panda Miti Kibiashara*, End of Dry Season Woodlot Assessment 2016/17. Iringa, Tanzania.

PFP. (2016). Private Forestry Programme – *Panda Miti Kibiashara*, Value Chain Analysis of Plantation Wood from the Southern Highlands. Iringa, Tanzania.

PFP. (2014). Private Forestry Programme – *Panda Miti Kibiashara*, "Desk Study for Developing Mechanisms and Policies That Strengthen the Private Plantation Forestry and Related Value Chains. Iringa, Tanzania.

Putnam, R. D. (1993) 'The prosperous community: social capital and public life' in the American Prospect, 4:13.

Reed, G. (2016). Assessing the Role of Social Networks in Agricultural Cooperatives in The Niayes Region of Senegal, Unpublished Master Thesis, McGill University, Montreal, Senegal.

RSA. (2012). The Republic of South Africa "A framework for the development of smallholder farmers through cooperative development. Pretoria, South Africa".8. Retrieved from http://www.nda.agric.za/does/sideMenu/cooperativeandenterprisedevelopment/docs/framework- of small farmers (2).pdf. Accessed on 22nd Dec. 2017.

RSB. (2013). Roundtable on Sustainable Biomaterials Suggestions, Defining Smallholders; Ecole Polytechnique Fédérale de Lausanne Energy Center - Lausanne, Switzerland. *Ecole Polytechnique Federale De Lausanne*, 31. Retrieved from http://energycenter.epfl.ch/files/content/sites/energy-center/files/projets/Bioenergy Team/Defining smallholders_v30102013.pdf. Accessed on 22 Dec. 2018.

Sanga, D. A. (2016). Value Chain and Rural Livelihoods: Analysis of *Acacia Mearnsii* (Black Wattle) Activities in Njombe and Lushoto Districts, Unpublished Master Thesis, Sokoine University of Agriculture, Morogoro, Tanzania.

Schlauch, W., Obradovic, D., and Dengel, A. (2012). Organizational Social Network Analysis – Case Study in a Research Facility 78–82. A published Master Thesis, University of Kaiserslautern, Germany.

Schmid, A. A., and Robison, L. J. (1995). Applications of Social Capital Theory. *Journal of Agricultural and Applied Economics*, *27*(1), 59–66. Retrieved from https://core.ac.uk/download/pdf/6231916.pdf. Accessed on 15th Dec. 2017.

Singunda, W. T. A. (2010). Economic Contribution of Private Woodlots To the Economy of Mufindi District; A Unpublished Master Thesis, Sokoine University Of Agriculture. Morogoro, Tanzania.

Snelder, D. J., & Lasco, R. D. (2008). Smallholder Tree Growing in South and Southeast Asia. Smallholder Tree Growing for Rural Development and Environmental Services., 3–33. https://doi.org/10.1007/978-1-4020-8261-0_1. Accessed on 2nd December 2017.

Spreen, M. (1992) 'Rare populations, hidden populations, and link-tracing designs: what and why?', Bulletin Methodologie Sociologique, vol. 36, 34-58.

Suyanto, S., Tomich, T. P., & Otsuka, K. (2001). Land tenure and farm management efficiency: The case of smallholder rubber production in customary land areas of Sumatra. Agroforestry Systems, 52(2), 145–160. https://doi.org/10.1023/A:1010625019030. Accessed on 14th October 2018.

Szulecka, J. & Secco, L. (2014). Local Institutions, Social Capital and Their Role in Forest Plantation Local institutions, social capital and their role in forest plantation governance : lessons from two case studies of smallholder plantations in Paraguay. International Forestry Review, 16(2), 180–190.

Thomson, S. (1997) Adaptive sampling in behavioral surveys, NIDA Research Monograph, 296-319.

Torgny, N., Palmroth, S., Ganeteg, U., Moshelion, M., Hurry, V., and Franklin, O. (2014). "Genetics of

Superior Growth Traits in Trees Are Being Mapped but Will the Faster-Growing Risk-Takers Make It in the Wild " 1141–48. https://doi.org/10.1093/treephys/tpu112. Accessed on September 14th, 2018.
URT. (1998). National Forest Policy, *92*(9), 98.
URT. (2011). Report on The Study To Develop A Strategy For Establishing Cost Effective Land Use Plans In Iringa And Njombe Regions, Dar es Salaam - Tanzania.
URT. (2013). The United Republic of Tanzania, Ministry of Natural Resources and Tourism, Forest Service Strategic Plan July 2010 – June 2013, Dar es Salaam, Tanzania.
URT (2017). The United Republic of Tanzania, Forest Plantation, and Woodlot Technical Guidelines, Ministry of Natural Resources and Tourism, Dar Es Salaam, Tanzania.
USAID. (2010). Performance Monitoring and Evaluation Tips Using Rapid Appraisal Methods, (5), 1–6.
Valente, T., & Pitts, S. R. (2017). An Appraisal of Social Network Theory and Analysis as Applied to An Appraisal of Social Network Theory and Analysis as Applied to Public Health : Challenges and Opportunities. https://doi.org/10.1146/annurev-publhealth. Accessed on 21st Nov. 2017.
Vogt, W. P. (1999) *Dictionary of Statistics and Methodology: A Non-Technical Guide for the Social Sciences*, London - UK.
WoodCluster. (2018). Baseline survey study report for Wood Cluster Project, Sokoine University of Agriculture - Morogoro, Tanzania.
World Bank. (1999). Social capital: conceptual frameworks and empirical evidence: an annotated bibliography. *Social Capital Initiative*, (5), 39. https://doi.org/http://siteresources.worldbank.org/intsocialcapital/Resources/Social-Capital-Initiative-Working-Paper-Series/SCI-WPS-05.pdf. Accessed on 29th November 2017.
Woolcock, Michael, and Deepa Narayan. 2000. "Social capital: Implications for development theory, research, and policy." *The World Bank Research Observer* 15: 225-249.

Yin, M. H. & Pretzsch J. (2018). An analysis of collective action in forest plantation establishment by FUGs (Case study in the dry zone of Myanmar) Introduction. https://doi.org/10.1017/CBO9781107415324.004. Accessed on 12th Nov. 2017.

Yin, R. K. (2006). Case Study Research - Design and Methods. *Clinical Research*, *2*, 8–13. https://doi.org/10.1016/j.jada.2010.09.005. Accessed on 21st Nov. 2017.
Yin, R. K. (1994). Case study research: Design and methods (2nd ed.). Beverly Hills, CA: Sage Publications.
Yin, R.K. (1984). Case Study Research: Design and Methods. Beverly Hills, Calif: Sage Publications.
Zahabu, E., Raphael, T., Athumani, S., Chamshama, O., Iddi, S., and Malimbwi, R.E. (2015). "Effect of Spacing Regimes on Growth, Yield, and Wood Properties of Tectona Grandis at Longuza Forest Plantation, Tanzania" http://dx.doi.org/10.1155/2015/469760. Accessed on September 15th, 2018.

8. Annexes

Annex 1. Questionnaires for in-depth household interview and Checklist

Village_____ Date of Interview: _____

Number of respondent: _____Enumerator_____

GPS Coordinates……..……

A. Socio-demographic characteristics of the households

1. Gender of household head Male [ ] =1 Female [ ] =2
2. Age of household head: _____ (years)
3. In total how many people live in the household? _____
4. Household composition by age (years)

1 = <5	2 = (6 -17)	3 = (18 - 30)	4 = 31 - 40	5 = 41 – 50	6 = 51 - 60	7 = > 60

* < 5 = infants, * (6 – 17) = children, > 18 = adults

5. Household head highest level of education

1 = Non-formal	2 = Primary	3 = vocational	4 = Secondary	5 = Tertiary

6. Household head main occupation

Farmer	Trader	Public servant	Casual Laborer

7. Residence of the woodlot owner in the village

1= Resident	2= Non-resident

B. Farmer's motivations, knowledge base and challenges to woodlots farming.

8. What motivates you to plant trees?
9. Motivations:
10. ……

    ……
11. How do you plant trees?

Activity	Labor (hired(/family)	Payments (if hired labor)

12. How do you manage your trees?

Year	Activity	Labor (hired(/family)	Payments (if hired labor)

13. From where did you get this knowledge?

Knowledge item/content	Source/Organization

14. Do you plan to plant more trees in future? Yes/No, how many_____, when_____
15. Why and from where do you get additional land?

    ……

    ……

    ……

    ……

16. What challenges do you face in managing your trees?
    1. _____
    2. _____
    3. _____
    4. _____
    5. _____
17. How do you tackle or deal with these challenges? (1 – 5 in question 14)
    1. _____
    2. _____
    3. _____
    4. _____
    5. _____

C. Tree species, products and performance.

18. Which tree species do you prefer to plant? And why?

No	Tree species	Reason for planting
1		
2		

19. Which products do you produce and sell/use for own consumption from different woodlot tree species?

No	Species	Product	Sale/own use
1			
2			
3			

20. What is the size of your plots/woodlot?

Woodlot	Size	Woodlot	Size
1		5	
2		6	
3		7	
4		8	

21. a) Are you happy about the performance of your woodlots? Yes/No

    b) What are criteria for you that you use to rank your woodlot as in "not good performance"

……

22. Performance _ (Rapid Appraisal = RA)

GPS Coordinates ……

No.	Criteria/observation	Performance [1 = Good, 2 = Not good]	Reasons
1	Gaps		
2	Bole quality		
3	Planting space		
4	Growth condition		
5	Pest attacks		
6	Woodlot cleanliness		

23. How many trees did you plant?

Total trees planted		Planting space	No/% of surviving trees	Area/ha or acre
Species 1				
Species 2				

24. What is your proposal as to what should be done to improve your woodlot performance?

……

……

D. Woodlot farmers, support organizations and their linkages.

25. Do you have any support from any person/organization/institution? …..Yes/No
26. If Yes, which person/organizations/institution, type of support and when last did you receive it?

No	Organization/institution	Type of support/service	Year/month
1			
2			
3			
No	**Farmer**	**Type of support/service**	**Year/month**
1			
2			
3			

27. What do you give to these organizations/farmers in return?

……

……

28. What else do supporting organizations expect from you?

……

……

29. What do these supporters do if you don't deliver what they expected from you?

……

……

THANK YOU FOR YOUR COOPERATION/ASANTE KWA USHIRIKIANO!

Annex 2. Organizational and institutional actor interview questionnaires

ACTOR…..…….. DATE ……...……PLACE……..

GPS Coordinates…….…….…….

30. Do/did you offer any support/service to woodlot farmers in (…….., …. And.…villages)? Yes/No……..
31. If Yes, which farmer(s), which support and when last did you offer it/or how often?

No	Farmers/associations /institutions	Village	Support/service	Lastly Year/month	How often/frequency
1					
2					

32. What do you receive from these clients in return?

……

What else do you expect from these clients?

……..…

34. What do you do if clients don't deliver your expectations?

……

35. Do you link/connect/cooperate with any other organization/institution? Yes/No……..

36. If Yes, which organizations/institutions, for what are you linked to and how often?

No	Organization/institution	Which cooperation/linkage	When lastly
1			
2			
3			

THANK YOU FOR YOUR COOPERATION/ASANTE KWA USHIRIKIANO.

Annex 3. Guiding Questions for Focused Group Discussion in TGA Villages

1. What is the name of your TGA…… is it registered Yes/No ……. when…..……..

Registration number…….

2. How are the leaders obtained?

3. How many members are in your TGA? And how do members join/register into TGA?

4. What guides the operation of the TGA?

5. What benefits do you get from being into TGAs?.....

6. What does TGA offer to non – members?.....

7. Are other tree growers free to join TGA? Yes/No……if yes, what are the qualifications

……...……

10. How do you communicate to other tree growers to join TGA? and why have not joined TGA?

7. During woodlots assessment, results have revealed your woodlots are performing good//not good…….. what is your opinion……..….

8. What is your reference for good/not good performance ……..…...……..

9. Which activities do you do together in your TGA?.....

11. Which aspects TGA has done better so far…… and which are not ……and what are your plans in future?.....

THANK YOU FOR YOUR COOPERATION/ASANTE KWA USHIRIKIANO!

Annex 4. Field pictures

Source: Author (2018)

Figure 20. A woodlot farmer pruning his trees using panga/machete in the study area

Source (Author, 2018)

Figure 21. Measurement of the planting space using a tape measure

Source: Author (2018)

Figure 22. Slab constructed fence at the resident of tree grower at Igowole villages

Source: Author (2018)

Figure 23. Pine and Eucalypt timber market (left) and eucalypts poles from woodlots in study areas.

Source: Author (2018)

Figure 24. Charcoal making kiln (left) and readymade charcoal (right) from Acacia

Source: Author (2018)

Figure 25. Woodlot farmer's log sawing by ding-dong mobile sawmill/processor

Source: Author (2018)

Figure 26. Slabs, sawdust (left), pine and eucalypt firewood (right) from farmer's woodlots

Figure 27. Researcher arriving village from woodlots (left) and researcher with respondents leaving the village to woodlot sites (right).